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INDIVIDUALIZED SCIENCE INSTRUCTIONAL SYSTEM

KNOW THE BUG

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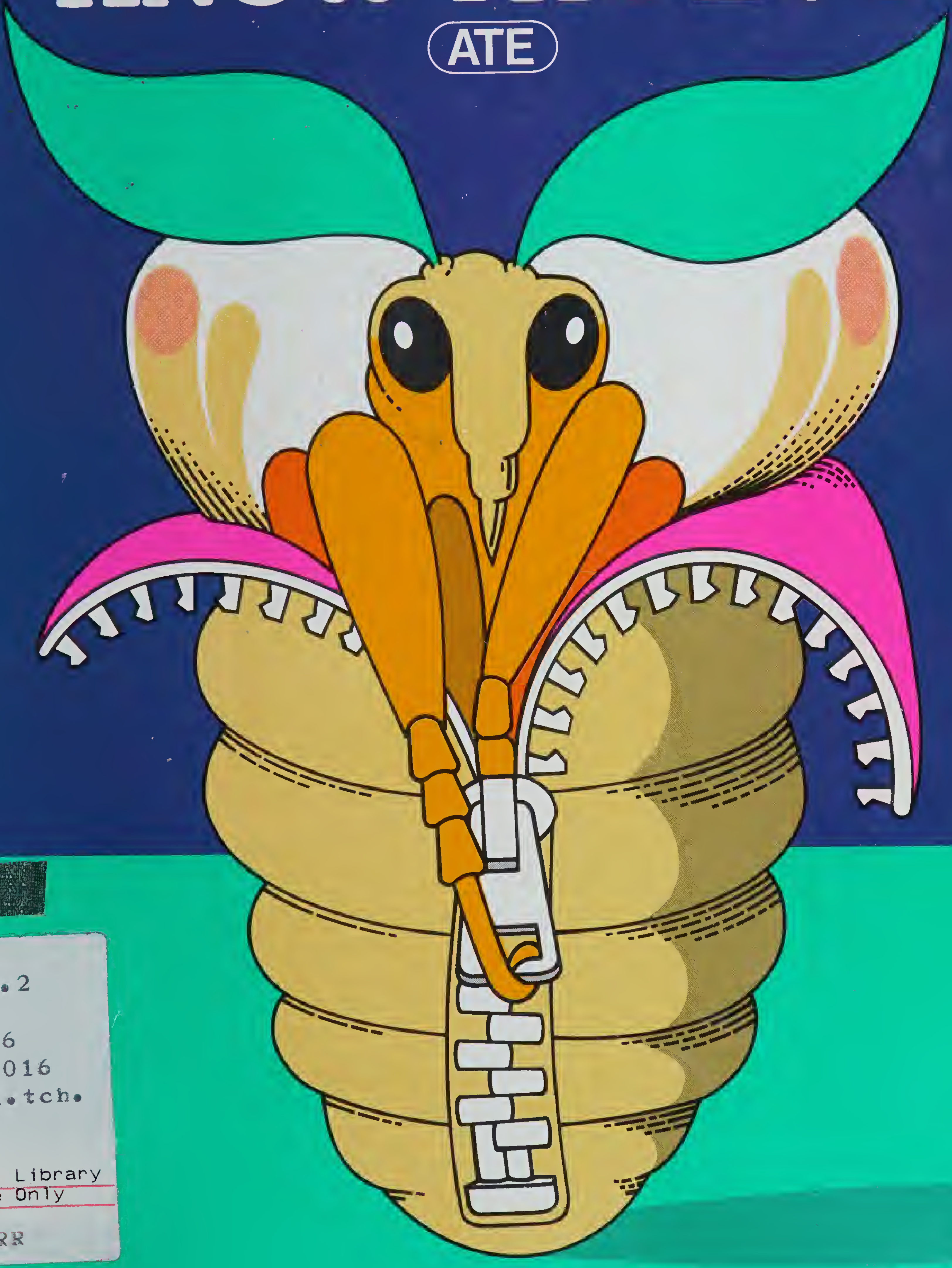

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ISIS

INDIVIDUALIZED SCIENCE INSTRUCTIONAL SYSTEM

KNOW THE BUG

ANNOTATED TEACHER'S EDITION

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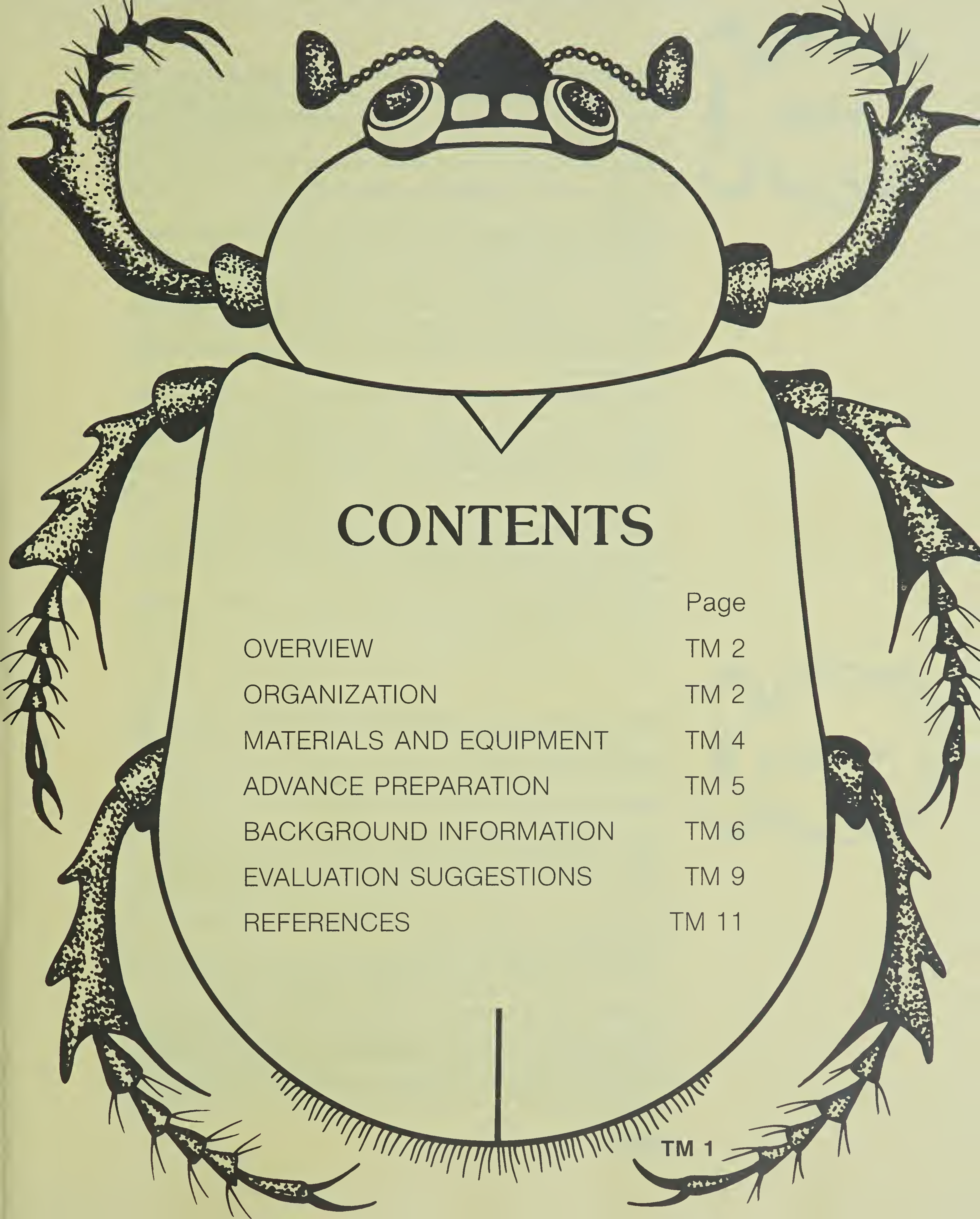

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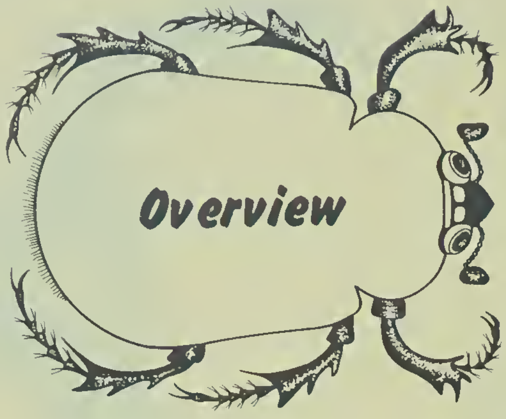


Overview

Know the Bug introduces the student to the most prolific group of living things on Earth. As used in this minicourse, the term "bug" refers to the creeping, crawling creatures that are found in all parts of the world. The term takes in the more than 600,000 species in the class *Insecta*. It includes scorpions, ticks, spiders, and mites, which belong to the class *Arachnida*. It also includes centipedes, of the class *Chilopoda*, and millipedes, of the class *Diplopoda*. All of these animals belong to the phylum *Arthropoda*.

Arthropods are by far the most biologically successful of any animals. Students learn the criteria for that success. For example, bugs have the highest number of species and individuals. They live in a wide variety of environments. They consume enormous amounts and varieties of food. They defend themselves admirably against enemies.

Know the Bug is particularly relevant because of the profound effect bugs have on our lives. Some bugs are beneficial. But others — a small percentage — are extremely damaging. They destroy crops, carry disease, and undermine wooden structures.

Know the Bug focuses on three main areas: (1) the structure, life cycles, and behavior of insects which account for their adaptability to a wide variety of conditions; (2) the effects of insects and other bugs on people; and (3) methods of controlling harmful bugs and their effects.

This minicourse can be used effectively in either a general science or a biology program.

Organization

This minicourse contains ten activities in the core section, three in the advanced section, and four in the excursion section. The planning activities must be done first in each section. Activity 2 should be done immediately following the core planning activity. Students begin to raise their own mosquitoes, which are needed in various stages of development in this and subsequent activities.

Core activities deal with simple morphology and life cycles of insects, the role of natural selection, identification of common pests and those which bite or sting, and ways by which the bug population is controlled. The consequences of artificial methods of control are also discussed.

Activity 8 is required of all students and treats an unusual and interesting aspect of insect behavior — cricket songs.

In the advanced activities, students have the opportunity to further examine the structure of insects through the dissection of a grasshopper. In addition, students study von Frisch's life-long work on how bees communicate. They learn how to design a scientific experiment.

The excursion activities deal with the prevention of breeding of houseflies, termite control, and the techniques by which bugs defend themselves against enemies.

Cassette Tape

The cassette tape for *Know the Bug* is an integral part of the minicourse. The tape has two bands, accompanying Core Activities 4 and 8. Activity 8 is required of all students.

The tape band for *Activity 4: Messing with Nature* deals with how industrial melanism has controlled the population of moths around Manchester, in northern England. The peppered moth in England exists in two varieties — light and dark. Before the Industrial Revolution, the light moth was more common because it often landed on trees that were light in color because of the lichens growing on the bark. By blending in with the tree color, the moths were protected and survived in larger numbers. Dark moths landing on the trees were more visible and were therefore eaten in greater quantity by birds.

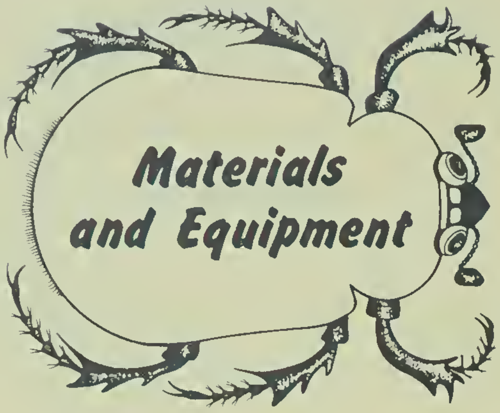
Industrialization produced smoke and soot that killed the lichens and darkened the barks of the trees. Eventually the light moths were more visible against the dark bark and this variety became fewer in number. Today, the air around Manchester has been cleared of soot and smoke. Lichens are growing again on trees. The result is that the dark moth is becoming more scarce since it is more visible against the light bark and is, therefore, not protected from its enemies.

Students listen to the tape for Activity 4 while looking at the illustrations in the student booklet. They move from one illustration to the next at the sound of a tone. At certain points, students stop the tape and answer questions.

The tape band for *Activity 8: Decoding Cricket Songs* deals with how crickets communicate with each other through "songs." The activity is the only one that is required. It deals with an aspect of animal behavior that is not treated in other activities — communication through sound.

Students listen to the actual recorded "songs" of crickets. Three types are identified: calling song, fighting song, and courting song. After listening to these songs several times, students are asked to identify these types of songs on their own.

Students may elect to use the cassette tapes somewhat differently than is prescribed in the student booklet. Such flexibility is not only acceptable but should be encouraged. For example, some students may prefer listening to the band for Activity 4 in its entirety before answering any questions.



Materials and Equipment

The following chart represents an estimate of needs based on "student units." The student unit may be one student working alone, two students working as partners, or several students working as a group. The size of the student unit will depend on the nature of the activity and on the availability of materials and equipment.

QUANTITY PER STUDENT UNIT	ITEMS	ACTIVITIES			NO. UNITS THAT CAN SHARE
		Core	Advanced	Excursion	
	Consumable				
	*Cigarette, nonfilter	7			
Small pack	Copper sulfate	6			
1 sheet	Filter paper	2			
1 pinch	*Food, cat or dog (dried)	2			
1 metre	Gauze, tubular #56	2			
	Grasshopper, large		12		
	*Insect spray	5			
3 drops	*Kerosene	6			
	*Labels, marking	2,6			
	Mosquito eggs on paper strip	2			
	*Tape, cellophane	2			
125 ml	Water, distilled	2,6			
1 pinch	*Yeast	2			
	Nonconsumable				
3	Beaker, 100 ml or jars or clear plastic cups	2,6			3
	*Cardboard, corrugated, 15 cm x 16 cm	2			1
	*Cassette player, preferably with earphones	4,8			5
	Cassette tape for *Know the Bug*	4,8			5
	*Coat hanger, wire	2			1
	Dissection kit		12		5
	Dissection pan or corkboard		12		5
	Dropper, medicine	6,7			5
	*Fish (Optional)	6			5
	*Fish net (Optional)	6			5
	*Glass or cardboard, 10 cm x 10 cm	2			1
	Lens, hand or dissecting microscope	2,5 6,7	12		1
	*Pencil, marking wax	2,6			10

*Items that can be obtained locally

Materials and Equipment (continued)

QUANTITY PER STUDENT UNIT	ITEMS	ACTIVITIES			NO. UNITS THAT CAN SHARE
		Core	Advanced	Excursion	
	Nonconsumable				
	*Pins, straight	12			5
	*Razor blades	12			10
	*Scissors	2			10
	Stirring rod	7			5
	Test tube, 16 mm x 150 mm (~20 ml)	2,7			5
	Test tube, 20 mm x 150 mm (~34 ml)	7			5
	Resource Unit 3	5			
	Resource Unit 15	6	13		

*Items that can be obtained locally.

Activity 2 Core Page 5

A supply of mosquito eggs is essential for this minicourse. A local public health bureau can help you find out where the eggs can be obtained. It is advisable to test the viability of any eggs you have on hand. Simply add some mosquito eggs and a pinch of dry yeast to distilled water. Hatching should begin within an hour.

You may want to save some of the coat hanger frames made by students in this activity for later use of this minicourse.

Activity 6 Core Page 32

Chlorine-free water is desirable for this activity. If it is not possible to collect rainwater or obtain distilled water, a suitable supply may be prepared by allowing water from the tap to stand in an open container for 24 hours.

Activity 7 Core Page 37

Students must learn to look at and interpret the labels of pesticide containers. They may do so at home, but in the event they do not, have several pesticide containers for students to examine for the ingredients contained in the pesticides. For safety, the containers should be empty and washed. See "Pesticides," page TM 7.

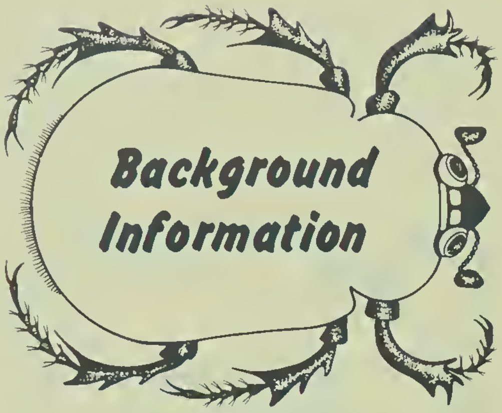
Activity 12 Advanced Page 55

Locally captured grasshopper specimens may be killed by placing them in a sealed jar, together with a wad of cotton soaked with ether or chloroform. If this is done just prior to the dissection, preservation will not be necessary.

If needed, a 70% alcohol solution makes a suitable preservative for a week or so. To make 100 ml of such an alcohol solution, add 70 ml of pure ethyl alcohol to 30 ml of water. For larger quantities, retain the same alcohol/water proportion.

If live grasshoppers are not available, purchase preserved grasshoppers from supply sources.

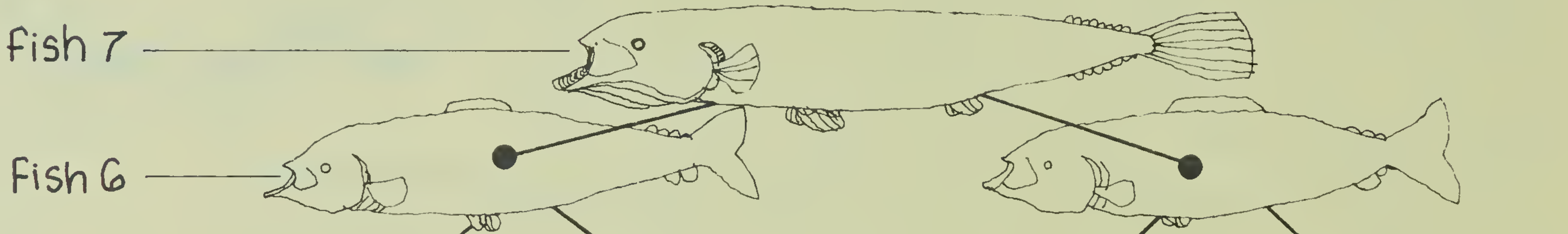
See "Anatomy of a Grasshopper" on page TM 8.



DDT: Boon or Doom?

The story of DDT — and its fall from favor — is discussed in Activity 9. Because DDT builds up in animals it is considered to be a hazard to the environment. For example, DDT can build up in fish, as shown in Figure 9-1, page 47.

The following diagram demonstrates how to compute the answer for Question 9-2 in Activity 9.



Pesticides

The compelling problem of using chemicals to control harmful bugs is dealt with in Core Activities 6, 7, and 9. There are many implications — to the individual, to the environment, and to society. Students must be aware of the pros and cons of the use of pesticides.

It is important to emphasize to students that all pesticides are hazardous if misused. Caution must be exercised in handling *any* pesticide. In most instances, the safest action is to call in a professional to apply the pesticide.

A professional pesticide applicator must be certified by the state in which he or she is working. Both federal and state laws and regulations apply to any person using pesticides. Certification for professionals has been essential because of the increase in the number of kinds of pesticides that are available. The hazardous effects of pesticides on wildlife and environment has been another important consideration.

Most pesticides are designed to control pests by poisoning them. Unfortunately many pesticides are poisonous to people as well. Pesticides enter the body in three ways: orally, dermally, and by inhalation. Some pesticides are very poisonous, or *toxic*, and may kill or seriously injure people. Others are fairly safe, or *nontoxic*. However, even nontoxic pesticides can irritate the skin, eyes, nose, or mouth.

Labels alert pesticide users to the toxicity of a pesticide. Four different categories have been designated: (1) highly toxic, (2) moderately toxic, (3) slightly toxic, and (4) relatively nontoxic. Signal words appear on each label, as shown below.

Category	**Signal Word**
Highly toxic	DANGER (skull and bones) POISON
Moderately toxic	WARNING
Slightly toxic	CAUTION
Relatively nontoxic	————

The term ''insecticide'' is often used synonomously with ''pesticide.'' Pesticides refer to all chemicals that control pests. *Insecticides* are chemicals that control insects.

Anatomy of the Grasshopper

The grasshopper is considered to be typical of the class *Insecta*. For this reason, students are asked to dissect a grasshopper in Advanced Activity 12. They are asked to identify certain important parts and to relate the structure of these parts to their function. The following serves as additional information on the main focus of the activity.

Like all insects, the body of the adult grasshopper has three main parts: head, thorax, and abdomen. The head has two compound eyes and three simple eyes. The compound eyes curve around the sides of the head and therefore have a broad field of vision. The head also bears a pair of long, jointed antennae and the mouth parts. The mouth parts consist of the upper lip called the *labrum*, a pair of toothy jaws called the *mandibles*, accessory jaws called the *maxillas*, and the lower lip called the *labium*. (See Figure 12-4 on page 58 of the student booklet.)

Dorsally the thorax is partly covered by a shield and by the wings. The thorax has three segments, each of which has a pair of legs. There are two pairs of wings. Each pair of wings has a separate function. The hind wings are used for flying; the forewings simply serve as a cover for the hind wings. When they are not in flight, the hind wings are folded and fit under the first pair of wings.

The abdomen contains much of the machinery of the body because, for one thing, it is the largest of the three parts. It has no appendages except those at the posterior end which function in mating and egg-laying. The abdomen contains much of the digestive system, the reproductive system, the excretory system, the nervous system, the circulatory system, and air tubes for respiration.

The digestive system consists of three parts: fore-gut, stomach, and intestine. The fore-gut starts at the mouth, continues as an esophagus, then leads to the crop, a large sac in the thorax. The crop stores large amounts of food, enabling the grasshopper to digest the food at its leisure. Food entering the crop is already mixed with salivary juices. The stomach is the main organ for digestion and absorption. It lies mainly in the abdomen. The intestine receives the waste products of digestion.

The excretory system consists of tubules called the *Malpighian tubules*, named after the person who discovered them. The wastes are in the form of crystals of uric acid, which are expelled through the anus.

The nervous system consists of a ventral, double cord containing ganglia. There are two ganglia in the head, three in the thorax, and five in the abdomen. The ganglia control the movements of the segments in which they are located. The brain, which is located between the eyes in the head, does not have any centers for directly controlling muscular activity.

In addition to the use of the minicourse test, you might want to use some or all of the following suggestions to evaluate your students.

Essay Questions

Four essay suggestions and their sample answers are included here. All are related to material found in the core activities.

1. Describe how to properly use insecticides to control insect pests.

Answer: It is first necessary to identify the pest, if possible, and then select a product which is appropriate for use with this insect. The instructions on the container should be followed carefully. Insecticides should not be used in the presence of food or children, nor placed into containers not intended for that purpose. Garden crops should be carefully washed before being eaten.

2. Describe some useful and some harmful effects of bugs on people.

Answer: Many bugs, mostly insects, may be considered harmful if they are simply plant pests, such as caterpillars, grasshoppers, boll weevils, and some beetles. Bugs such as flies and mosquitoes are carriers of diseases which are harmful to humans. Still others are venomous, such as some spiders, wasps, and scorpions. Some bugs, such as silkworms and bees, produce useful products. Others perform useful services: bees pollinate flowers, some beetles break down animal refuse.

Student responses will be influenced by any additional reading they may do.

3. Suggest how bites or stings from various kinds of bugs are best treated.

Answer: It is first important to try to identify the bug. Is the bug a plant pest, a carrier of disease, or venomous? If the bug is likely to be venomous, a doctor should be consulted immediately. Use ice to reduce swelling; a soothing antiseptic lotion or local anesthetic to reduce pain or itching.

4. How might using another insect or some other animal to control an insect pest prove harmful?

Answer: It is possible for the insect or other animal to become so successful in controlling the pest, that it becomes a pest itself. If it changes its diet to include useful insects or perhaps plants, it could do great harm to the balance of nature.

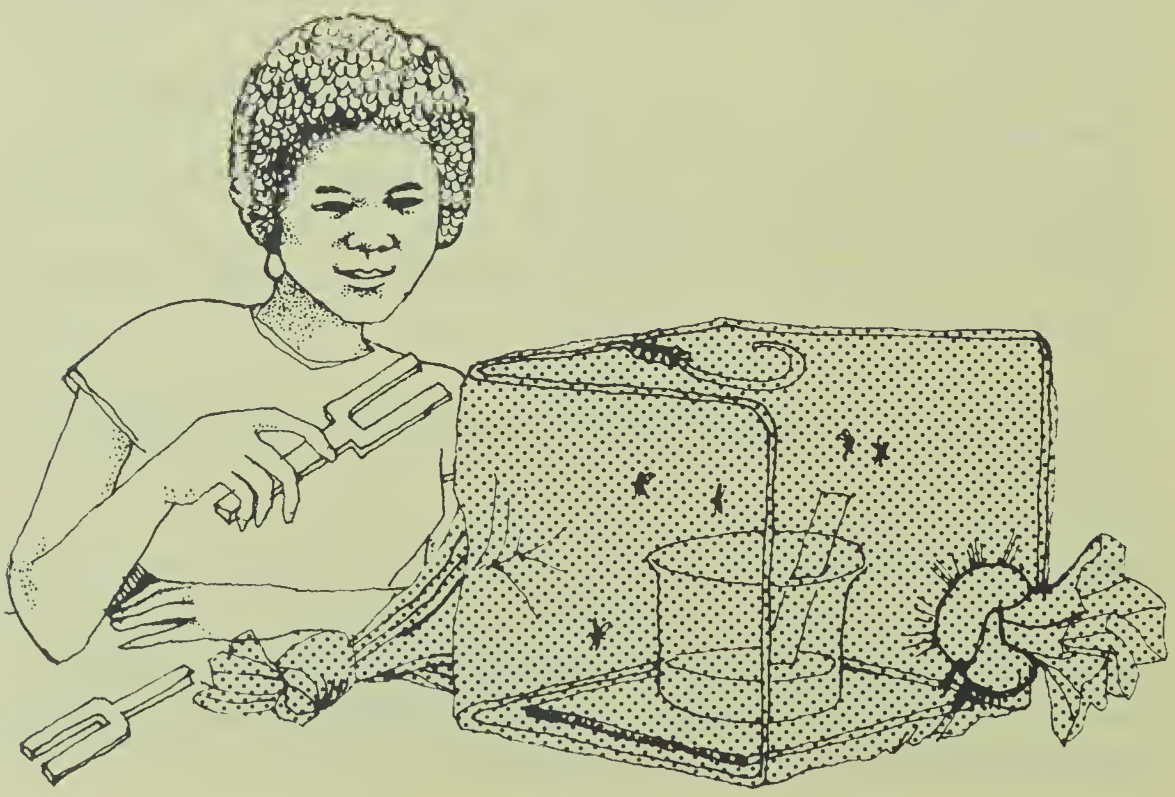
Laboratory Performance

This problem deals with the response of mosquitoes to sounds of different pitch. Students who have done *Sounds of Music* know that frequency determines pitch. Advanced students will particularly benefit from this lab experience.

Students will need these items:
- set of tuning forks (with one around 440 cps) or a signal generator.
- mosquito cage with at least 20 adult mosquitoes of both sexes.
- *Resource Unit 15,* "What's An Experiment?"

Preamble: The high-pitched buzz of a mosquito comes from the to-and-fro vibration of its wings. The female, being a little larger than the male, vibrates its wings a little more slowly than does the male. This gives the buzzing a lower pitch.

Can mosquitoes detect this difference in pitch? If so, the lower-pitched buzzing of the female could be a mating signal that attracts the male.

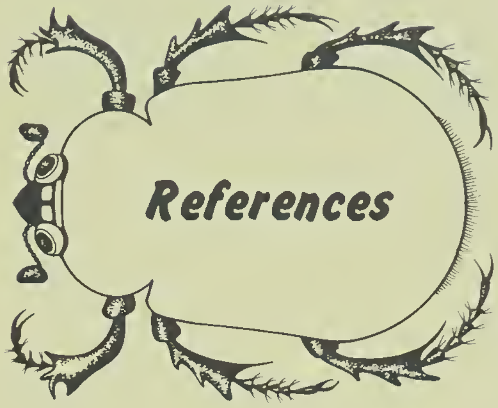


Problem: Devise and carry out an experiment to try to answer this question: "Do male and female mosquitoes respond to notes of different pitch?"

Without too much trouble, students will find that a pitch of about 440 vibrations per second will attract the *male* mosquitoes and cause them to flutter around the tuning fork.

Students could be evaluated on the following:

1. Accuracy of their findings.
2. Description of their experimental design and findings.
3. General skill and enthusiasm in carrying out the task.



References

Bentley, David, and Hoy, R. R. 1974. The neurobiology of cricket song. *Scientific American*. 231:14, 34–44.

This article provides informative and interesting reading for teachers and advanced students. Since the article discusses the relationship between song patterns, the nervous system, and genetics, students may benefit more if they have previously experienced the ISIS minicourse, *Generation Link*.

Borror, D. J., and White, R. E. 1970. *Field guide to the insects of America north of Mexico*. Boston: Houghton Mifflin Co.

A useful teacher and student reference for the identification of a wide variety of species.

Farb, Peter. 1962. *The insects*. New York: Life Nature Library. Time, Inc.

A well-illustrated and comprehensive treatment of insect morphology and behavior. Particularly suited for students of all levels.

Fitcher, G. S. 1966. *Insect Pests: A guide to more than 350 pests of home, garden, field, and forest*. New York: A Golden Nature Guide, Golden Press.

Levi, Herbert W., and Levi, Lorna R. 1968. *Spiders and their kin*. New York: A Golden Nature Guide. Golden Press.

Zim, Herbert S., and Cottam, Clarence. 1956. *Insects: A guide to familiar american insects*. New York: A Golden Nature Guide. Golden Press.

The latter three references are extremely useful for teachers and students alike. Each contains a comprehensive field identification guide together with more general information on life cycles and behavior. They may be readily used by students at all levels.

The following U.S. Department of Agriculture publications are available at low cost from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Home and Garden Bulletins

HG 28. *Ants in the home and garden: how to control them.*
HG 53. *Lawn insects: how to control them.*
HG 64. *Subterranean termites.*
HG 67. *Insects and related pests of house plants.*
HG 84. *Controlling mosquitoes in your home and on your premises.*
HG 96. *Controlling household pests.*
HG 113. *Protecting woolens against clothes moths and carpet beetles.*
HG 121. *Controlling fleas.*
HG 122. *Controlling wasps.*
HG 137. *Controlling chiggers.*
HG 158. *Beekeeping for beginners.*
HG 190. *Insects on deciduous fruits and tree nuts in the home orchard.*
HG 200. *Be safe from insects in recreation areas.*

Leaflets

L 412. *Silverfish and firebrats: How to control them.*
L 453. *How to control bedbugs.*
L 540. *Periodical cicadas (17-year locusts).*
L 558. *Controlling wood-destroying beetles in buildings and furniture.*
PA 589. *Safe use of pesticides in home and garden.*

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FOREWORD

Evidence has been mounting that something is missing from secondary science teaching. More and more, students are rejecting science courses and turning to subjects that they consider to be more practical or significant. Numerous high school science teachers have concluded that what they are now teaching is appropriate for only a limited number of their students.

As their concern has mounted, many science teachers have tried to find instructional materials that encompass more appropriate content and that allow them to work individually with students who have different needs and talents. For the most part, this search has been frustrating because presently such materials are difficult, if not impossible, to find.

The Individualized Science Instructional System (ISIS) project was organized to produce an alternative for those teachers who are dissatisfied with current secondary science textbooks. Consequently, the content of the ISIS materials is unconventional as is the individualized teaching method that is built into them. In contrast with many current science texts which aim to "cover science," ISIS has tried to be selective and to limit our coverage to the topics that we judge will be most useful to today's students.

Obviously the needs and problems of individual schools and students vary widely. To accommodate the differences, ISIS decided against producing tightly structured, pre-sequenced textbooks. Instead, we are generating short, self-contained modules that cover a wide range of topics. The modules can be clustered into many types of courses, and we hope that teachers and administrators will utilize this flexibility to tailor-make curricula that are responsive to local needs and conditions.

ISIS is a cooperative effort involving many individuals and agencies. More than 75 scientists and educators have helped to generate the materials, and hundreds of teachers and thousands of students have been involved in the project's nationwide testing program. All of the ISIS endeavors have been supported by generous grants from the National Science Foundation. We hope that ISIS users will conclude that these large investments of time, money, and effort have been worthwhile.

Ernest Burkman
ISIS Project
Tallahassee, Florida

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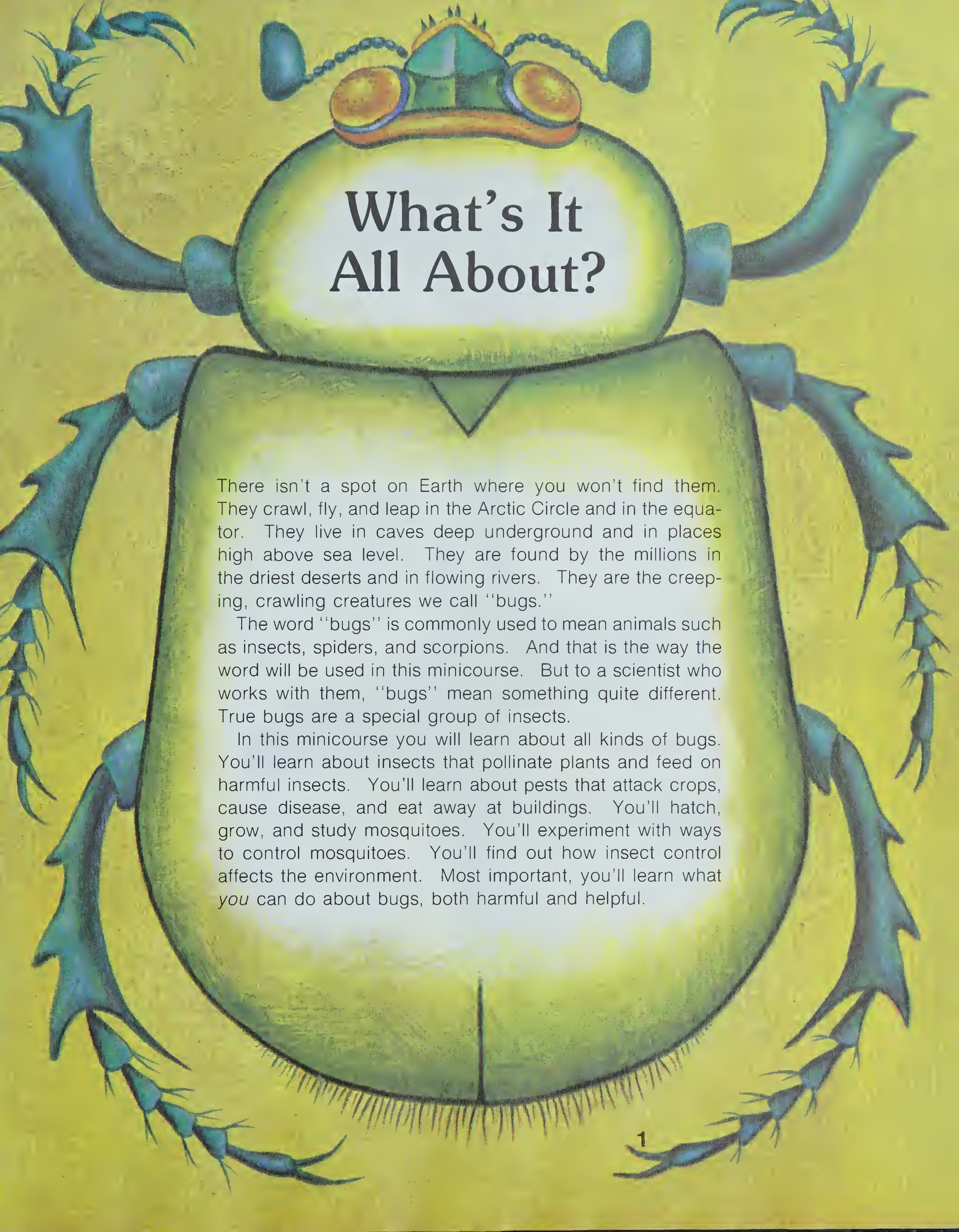


What's It All About?

There isn't a spot on Earth where you won't find them. They crawl, fly, and leap in the Arctic Circle and in the equator. They live in caves deep underground and in places high above sea level. They are found by the millions in the driest deserts and in flowing rivers. They are the creeping, crawling creatures we call "bugs."

The word "bugs" is commonly used to mean animals such as insects, spiders, and scorpions. And that is the way the word will be used in this minicourse. But to a scientist who works with them, "bugs" mean something quite different. True bugs are a special group of insects.

In this minicourse you will learn about all kinds of bugs. You'll learn about insects that pollinate plants and feed on harmful insects. You'll learn about pests that attack crops, cause disease, and eat away at buildings. You'll hatch, grow, and study mosquitoes. You'll experiment with ways to control mosquitoes. You'll find out how insect control affects the environment. Most important, you'll learn what *you* can do about bugs, both harmful and helpful.

Core

Activity 1 Planning

Activity 2 must be done first. Get it started right after doing this planning activity. Follow the growth of your mosquitoes carefully.

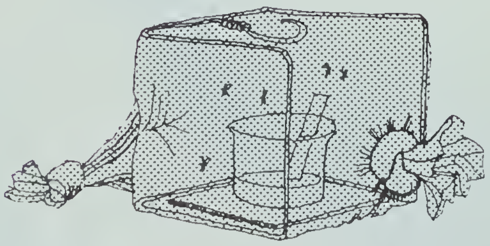
Some activities require mosquito larvae and adults.

- Activities 6 and 7 require wrigglers from Activity 2.
- Activity 5 requires adult mosquitoes from Activity 2.

Do the rest of the activities in any order.

Activity 2 Page 5

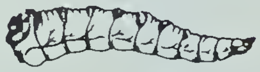
In this activity you'll grow your own mosquitoes. You'll feed them and watch them grow from egg to adult. You'll use the mosquito at different stages of its growth in other activities.



Activity 3 Page 13

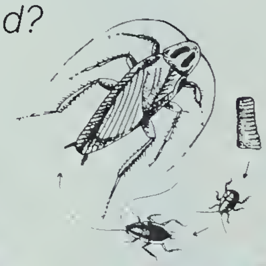
Objective 1: Describe the stages in the life cycle of a housefly.

Sample Question: What stage of the life cycle of the housefly is shown in the picture?



Objective 2: Describe the life cycle of the cockroach.

Sample Question: The cockroach that hatches from the egg looks like a tiny copy of the adult. What is this type of metamorphosis called?



Activity 4 Page 17

Objective 3: Define the term "natural selection" and tell how it explains the survival of different insects.

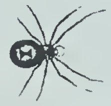
Sample Question: Natural selection is a theory that explains how living things

a. choose their mates for reproduction.
b. adapt to changes in their environment.
c. choose the environment in which to live and reproduce.

Activity 5 Page 22

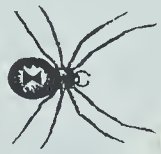
Objective 4: Identify common or important local insects and those seen on television and in publications.

Sample Question: This is a picture of a ____?____.



Objective 5: Describe how to avoid venomous insects and spiders and how to treat their bites or stings.

Sample Question: (True or False) If someone is bitten by the animal shown, call a doctor or poison control center immediately.



Activity 6 Page 32

Objective 6: Describe how to kill insect pests with chemical sprays, powders, oil or kerosene films.

Sample Question: Which of the following would kill mosquito larvae with the least harm to other life?

a. oil or kerosene film
b. copper sulfate
c. DDT
d. pyrethrum

Activity 7 Page 37

Objective 7: Describe how common insecticides kill insect pests.

Sample Question: Match each of the three kinds of insecticides in List A with a description of how it works in List B.

List A
a. stomach poisons
b. contact poisons
c. fumigants

List B
1. chemicals go through the body wall to kill
2. chemicals kill insect after being eaten
3. chemicals destroy insect tissues when insect touches them
4. poisonous gases kill insect after being breathed in

Answers
1. larva 2. gradual metamorphosis
3. b 4. black widow spider
5. true 6. a 7. a2, b1, c4

Activity 8 Page 44

Required Activity — Make sure you do this one . . . .

Activity 9 Page 46

Objective 8: Explain why some insecticides such as DDT are banned.

Sample Question: Why is DDT no longer used in the United States?

a. New insecticides killed insects better.

b. More and more DDT was needed to kill the pests, which made it too expensive to use.

c. DDT passed on from animal to animal in the food chain.

Activity 10 Page 50

Objective 9: Describe how insect populations are controlled by natural enemies.

Sample Question: There are ways of controlling insect pests that don't rely on insecticides. Some of the living things that do not control insect numbers are

a. insect-eating birds.

b. other insects.

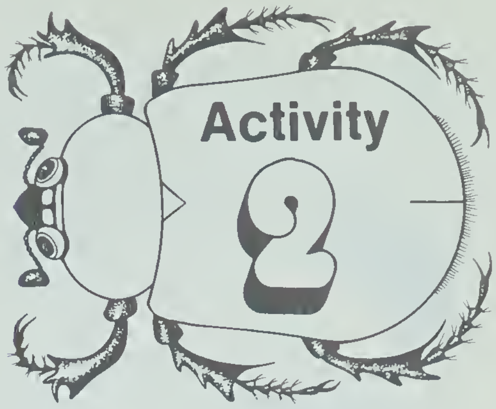
c. red algae.

Answers

8. c 9. c

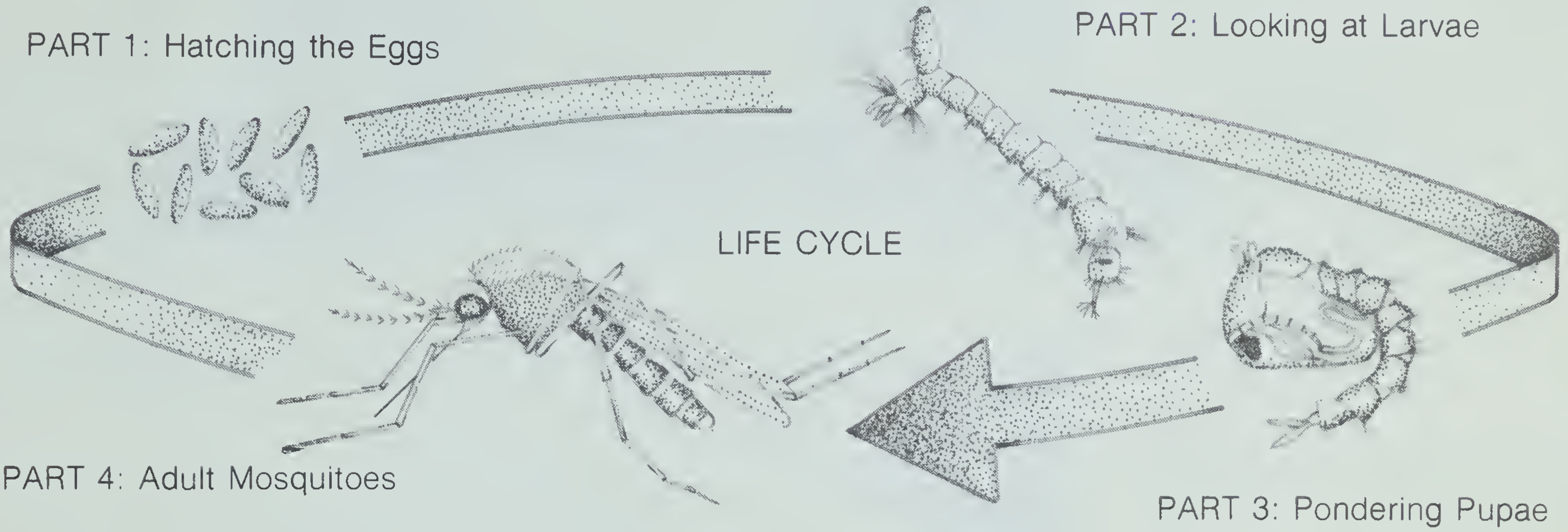
ACTIVITY EMPHASIS: A description of the four stages in the life cycle of the mosquito (egg, larva, pupa and adult) and a technique for raising mosquitoes.

Getting Started



You will raise your own mosquitoes in this activity — from egg to full-grown adult. The mosquito's life is made up of four stages. In each stage the mosquito looks different and leads a different kind of life.

Each part of this activity is matched to a different stage of the mosquito's life cycle. See the illustration below.



The mosquito is an example of an insect that undergoes a complete change from egg to larva, from larva to pupa, and from pupa to adult. This kind of change is called *complete metamorphosis*. Complete metamorphosis means that the egg looks different than the larva, the larva looks different than the pupa, and the pupa does not look like the adult insect.

MATERIALS PER STUDENT UNIT

beaker, 100 ml, or clear plastic cup
cardboard, corrugated, 15 × 16 cm
coat hanger, wire
gauze, tubular #56
glass or cardboard, 10 cm × 10 cm
labels, marking
lens, hand, or dissecting microscope
mosquito eggs on paper strip
paper, filter, 1 sheet
pencil, marking wax
scissors
tape, cellophane
test tube, small
water, distilled, 25 ml
yeast, 1 pinch
dry cat or dog food

PART 1: HATCHING THE EGGS

Begin with this part of the activity. You will need these items:

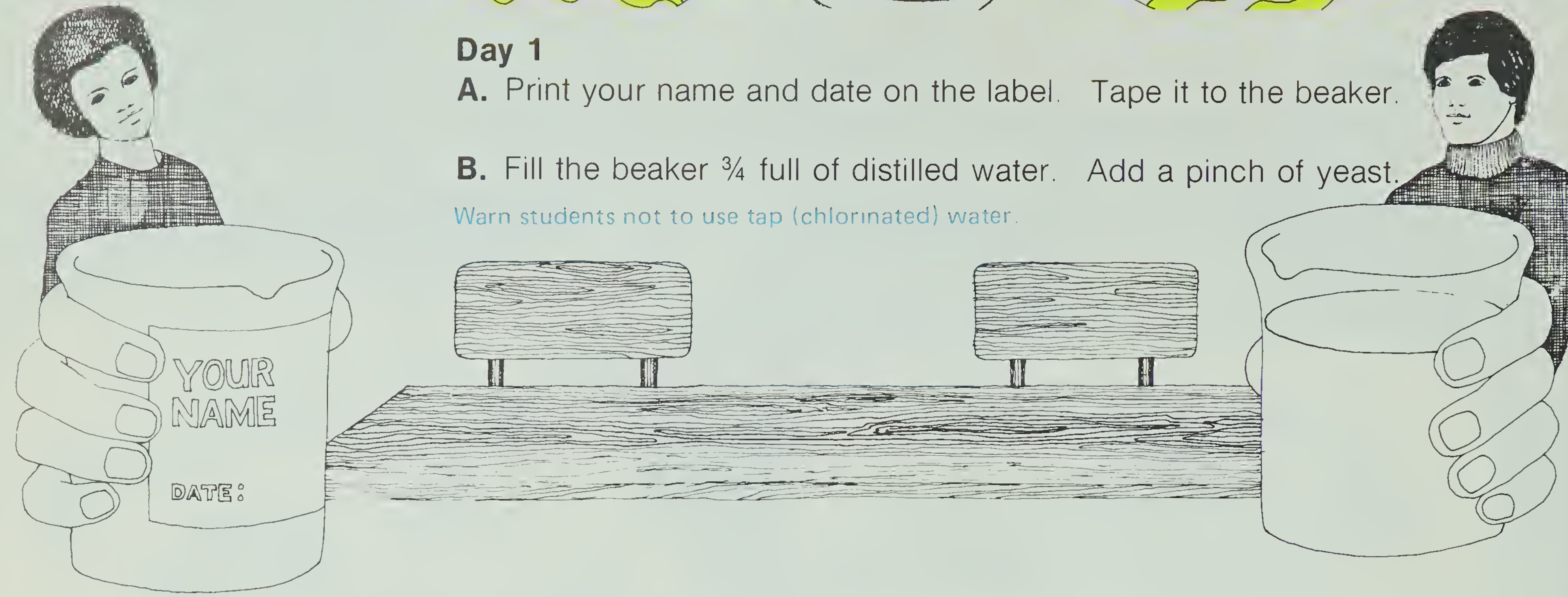
100 ml beaker or clear plastic cup
label
marking pen or pencil
cellophane tape
distilled water
mosquito eggs on paper strip
scissors
hand lens or dissecting microscope
yeast
dry cat or dog food

Day 1

A. Print your name and date on the label. Tape it to the beaker.

B. Fill the beaker ¾ full of distilled water. Add a pinch of yeast.

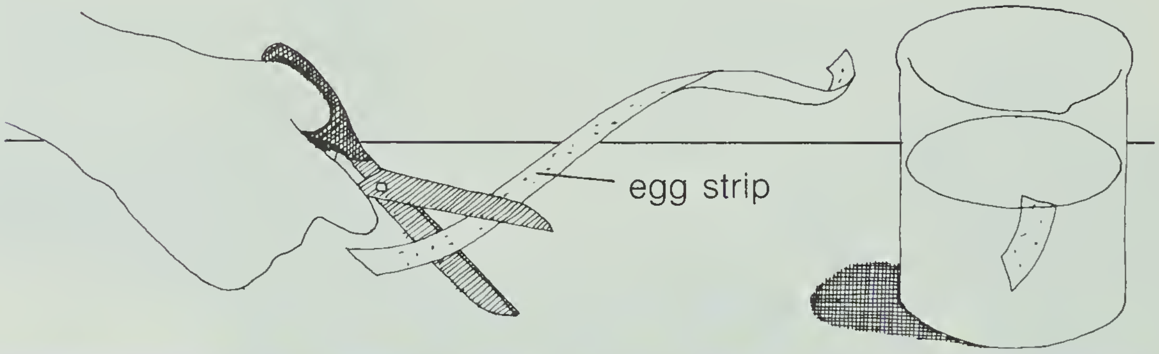
Warn students not to use tap (chlorinated) water.



C. Cut off a paper strip with 20 to 25 eggs on it. The pieces should be about 2 cm long.

Beakers should not be set up in a draft or cold spot.

D. Place your strip in your beaker.



One Hour Later

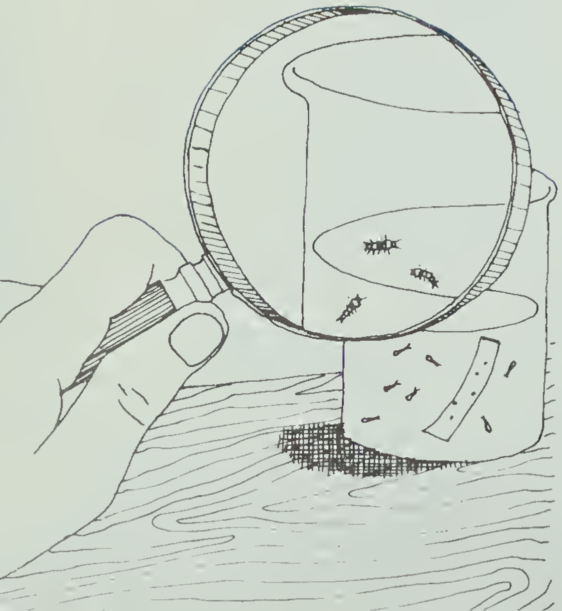
The eggs should begin to hatch within an hour. The egg is the first stage in the mosquito's life cycle.

Some eggs just won't hatch. Give up on them.

E. Watch the eggs hatch with a hand lens or dissecting microscope. Each moving speck you see is called a *larva*. Because of the way the larva moves around, it is sometimes called a *wriggler*.

✓ 2–1. Describe what you see through the hand lens or microscope. Draw a sketch in your notebook.

2-1. Several long, thin white specks are wriggling around the water.



GO BACK TO THE PLANNING ACTIVITY

Point out to students that Steps F, G, and H will be completed over the next six days. They should read through these steps before returning to the Planning Activity.

Wrigglers can be kept in an aquarium.

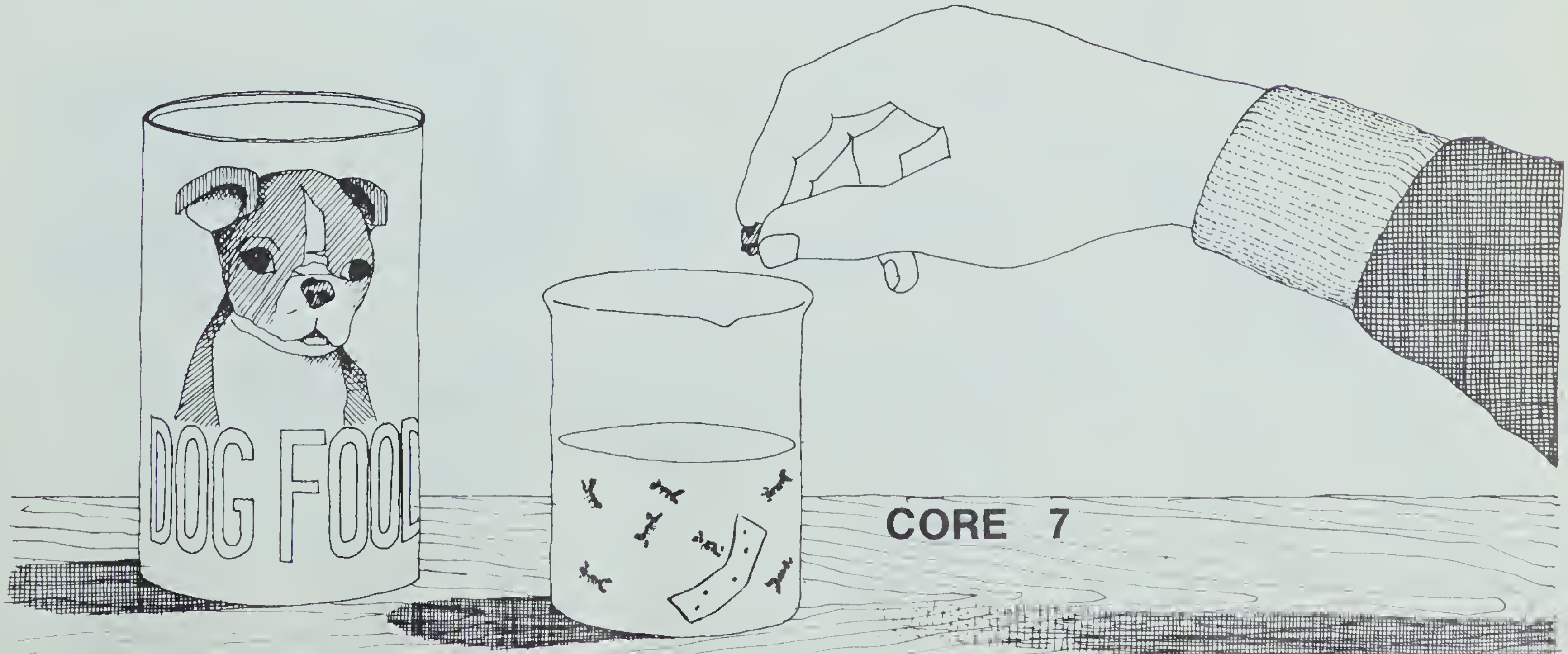
The wrigglers are too small now to be seen easily. They need about five days to grow. In the meanwhile, do another activity that doesn't require mosquitoes. BUT DON'T FORGET TO FEED YOUR MOSQUITOES. Follow these steps:

Day 2 Warn students not to add too much yeast.

F. Add a pinch or two of yeast to the water. Don't put in any more!

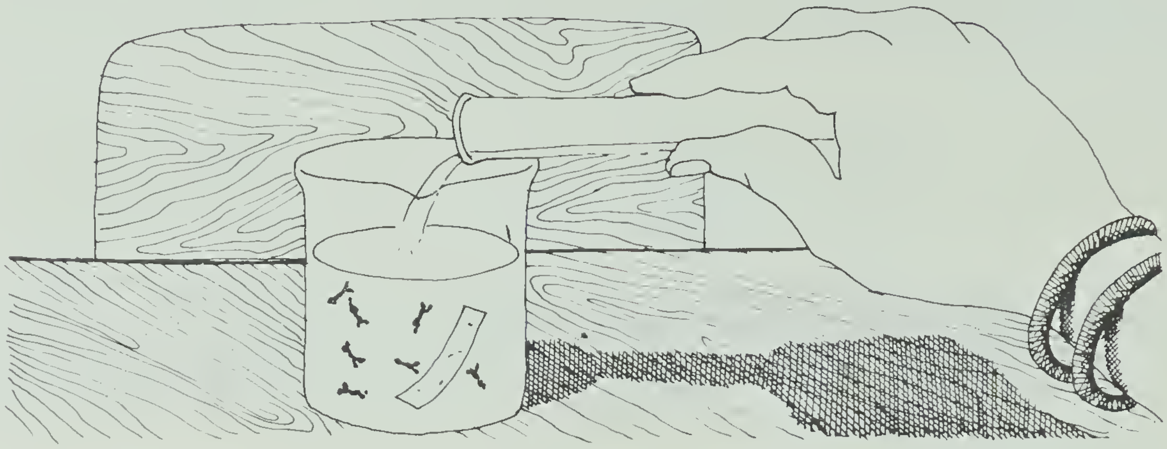
Day 3

G. Add a pinch of finely ground, dry dog food to the water.



Days 4 to 7

H. Add water as necessary to keep the beaker ¾ full.

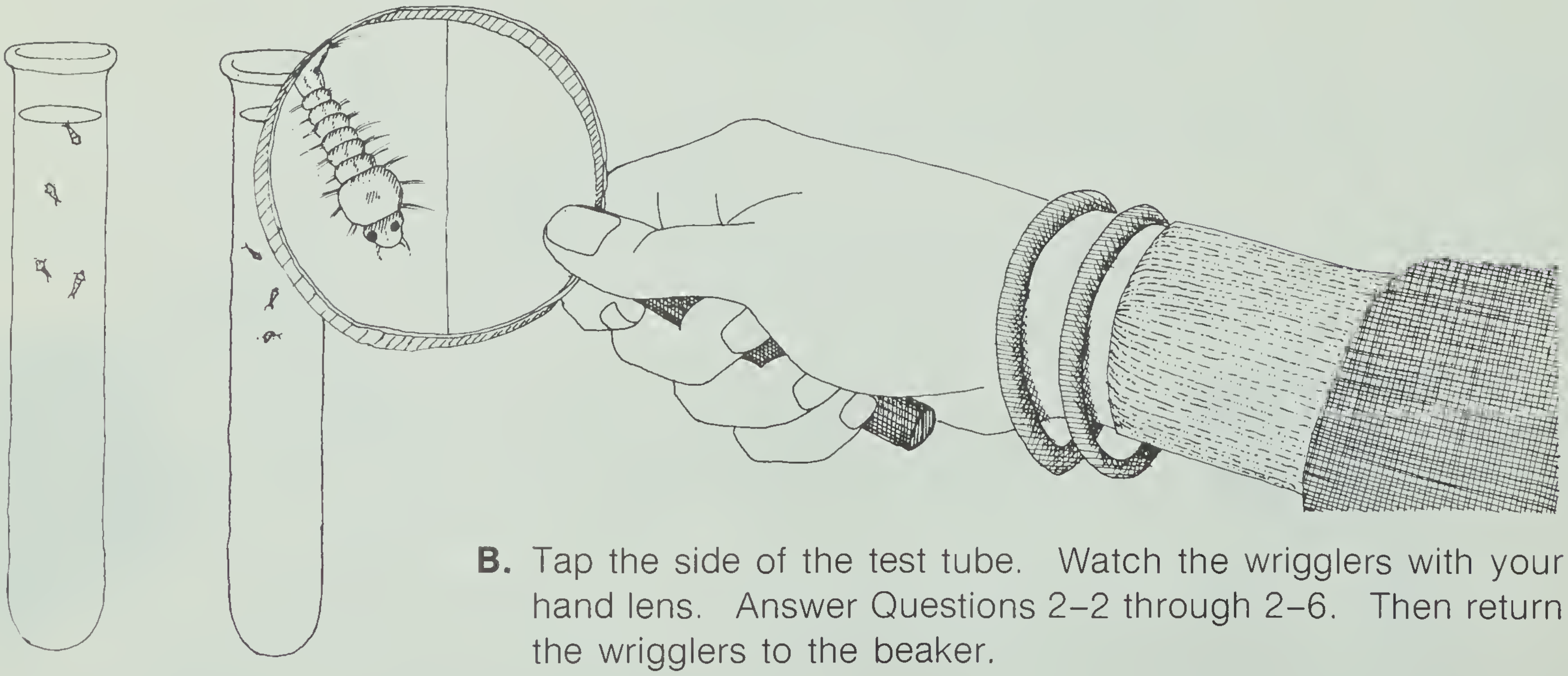


PART 2: LOOKING AT LARVAE

The larva is the second stage in the mosquito's life cycle. Observe how it looks and how it behaves. You will need the following items:

wrigglers from Part 1
small test tube
hand lens

A. Pour a few wrigglers into the test tube.



B. Tap the side of the test tube. Watch the wrigglers with your hand lens. Answer Questions 2–2 through 2–6. Then return the wrigglers to the beaker.

✓ 2–2. Describe in your notebook how the wrigglers respond.

✓ 2–3. Watch one wriggler. Does it always go back to the surface? Why do you think this is so?

✓ 2–4. Larvae usually feed upon small pieces of rotting plant and animal matter in ponds and streams. What are your larvae feeding on?

✓ 2–5. Try to observe a larva feeding. Does it seem to have a mouth?

✓ 2–6. The body of the larva has segments like a caterpillar or worm. How many segments can you observe?

IMPORTANT: If you plan to do Activities 6 and 7, do them now! These activities will require wrigglers.

2-2. Wrigglers dive from the surface, stay submerged for a while, then return to the surface. Some stay submerged longer than others.

2-3. Yes, though not always in the same amount of time as other wrigglers. The wriggler returns to the surface for air to breathe.

2-4. The larvae are feeding on yeast and dog or cat food.

2-5. Yes, on one side of its head.

2-6. Nine segments in addition to the head. The important idea is not the number but the fact that the larva can wriggle because its body is segmented.

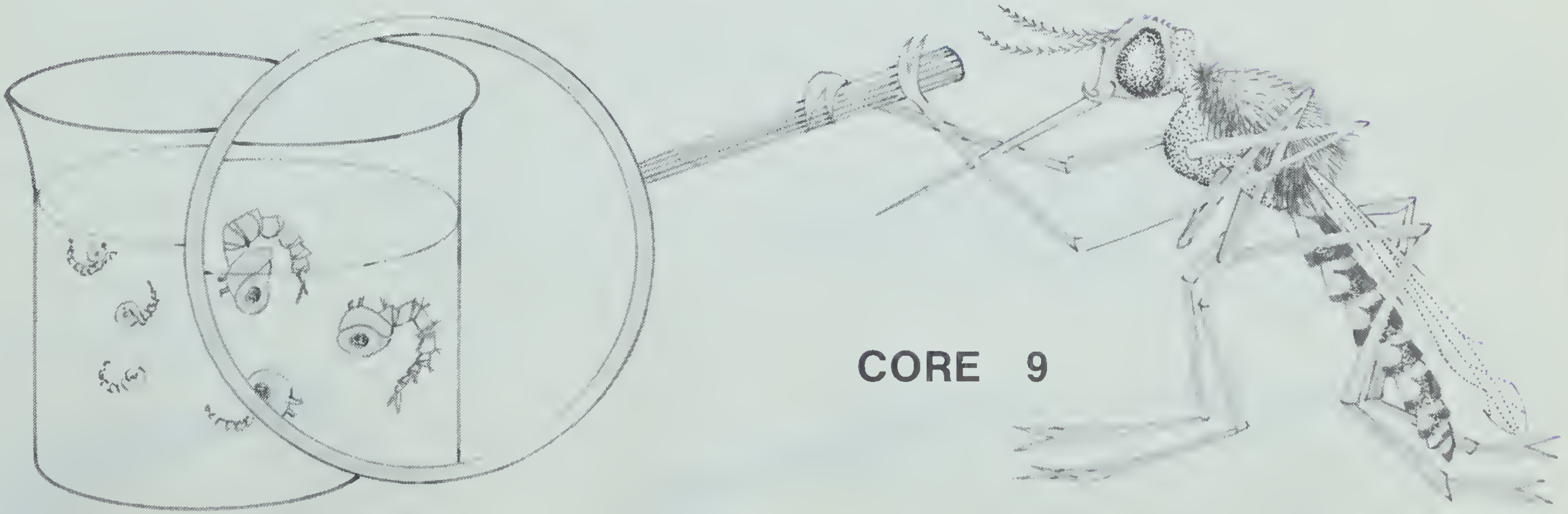
PART 3: PONDERING PUPAE

About seven days after hatching from the egg, the larva will begin to change into a new form called a *pupa*. This is the third stage in the mosquito's life cycle. Pupae aren't shaped like larvae. There are other important differences too. You'll need the following items for this part of the activity:

mosquito pupae
hand lens or microscope
1 metre of tubular gauze, #56
scissors
filter paper strip
piece of corrugated cardboard 15 cm x 16 cm
wire coat hanger

A pair of discarded panty hose is just as good, if there are no rips in it.

A. Use a hand lens or microscope to observe the pupae. Answer Questions 2–7 through 2–9 as you watch the pupae.



2-7. The pupa is larger, has an oval shape, and a tail that is shorter than that of the larva.

2-8. Yes. The pupa has two breathing tubes on the large, oval head-like part.

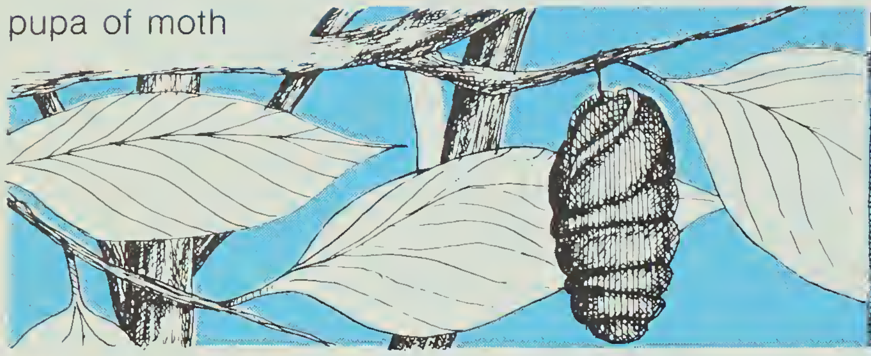
2-9. No. Pupae move less often and spend more time at the surface than the larvae.

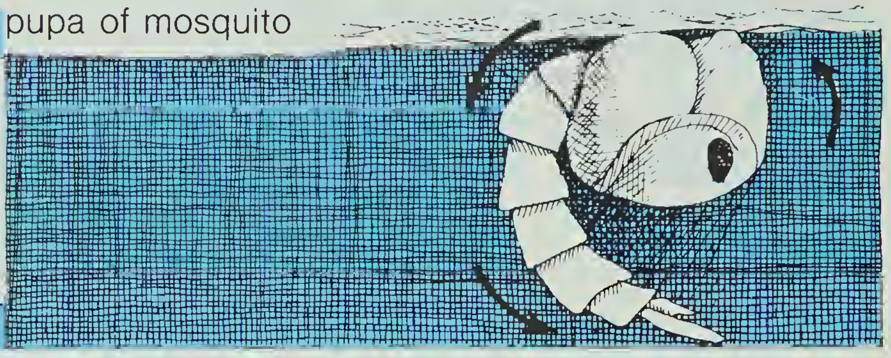
✓ 2–7. How is the shape of the pupa different from that of a larva?

✓ 2–8. Does the pupa have breathing tubes? If so, where are they? How many are there?

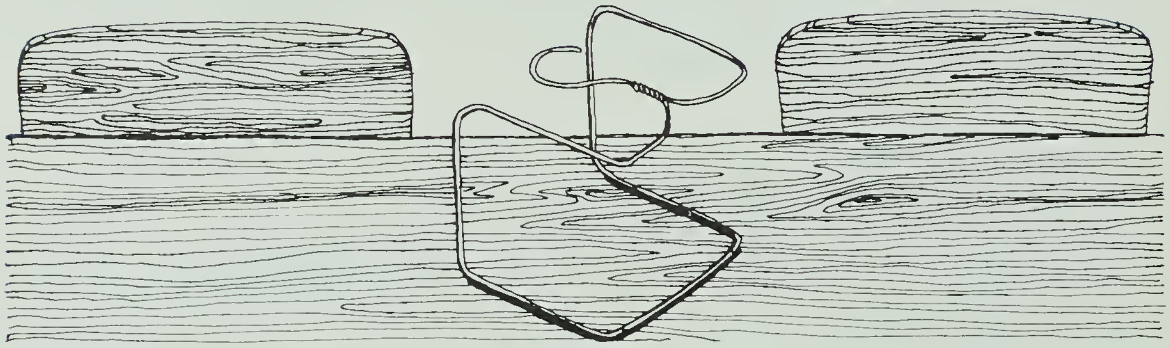
✓ 2–9. Are the pupae as active as the larvae? How would you describe the way they move?

Pupae of various insects behave differently. The pupa of a moth or butterfly, for instance, doesn't move around. The pupa of a mosquito does move. Because of the way it moves, it is called a "tumbler." Adults will hatch out of the pupae in about one or two days. You must build a cage so they don't get away.

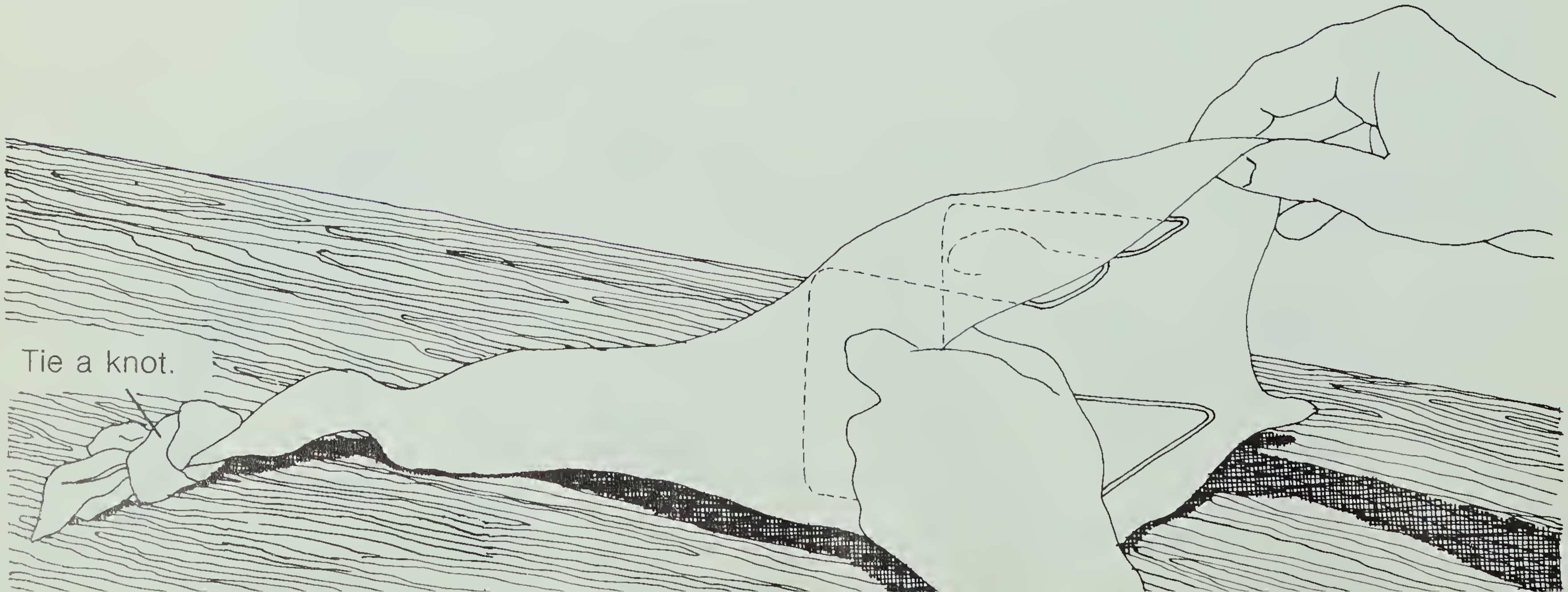

pupa of moth


pupa of mosquito

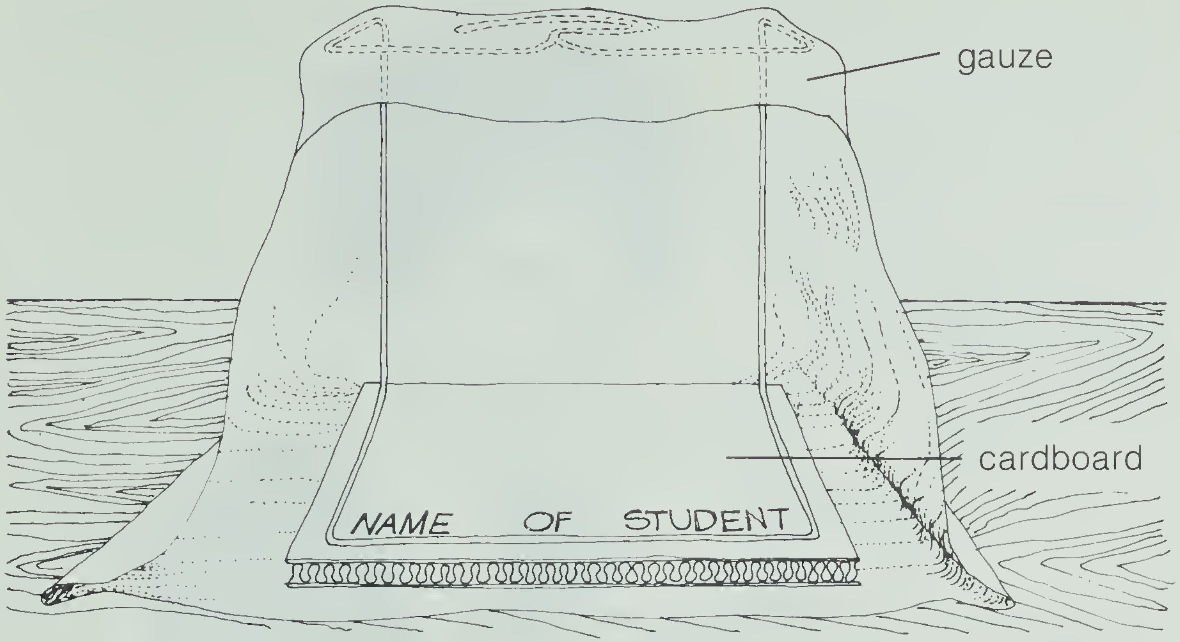
B. Bend a wire hanger in the shape shown in the drawing. Try to get the sides as square and parallel as you can.



C. Cut 1 metre of the tubular gauze. Tie a knot at one end. Stretch the other end of the gauze open and slide it over the wire hanger.

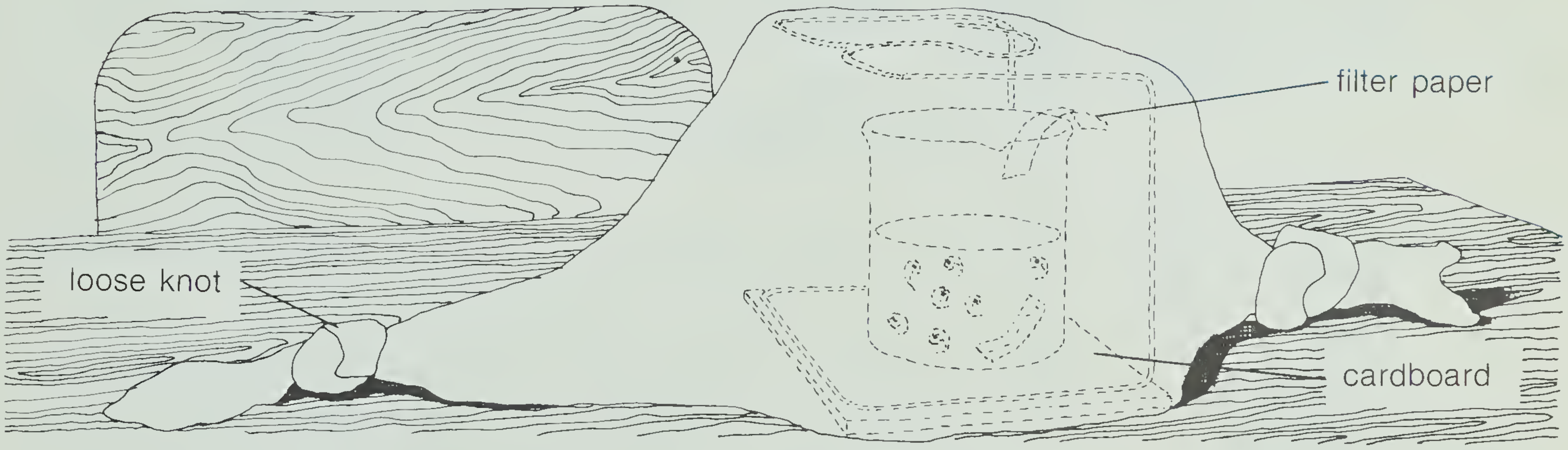


D. Write your name on the piece of cardboard. Then carefully slide it under the bottom of the wire hanger frame. The cardboard should be between the wire and the gauze.



E. Place a strip of filter paper so it hangs over the side of the beaker inside your cage through the open sleeve. Knot the sleeve loosely. Carefully set the cage and beaker aside in a safe place. Carry it by the bottom.

The filter paper provides a place to which the adult mosquitoes can fly and be seen.

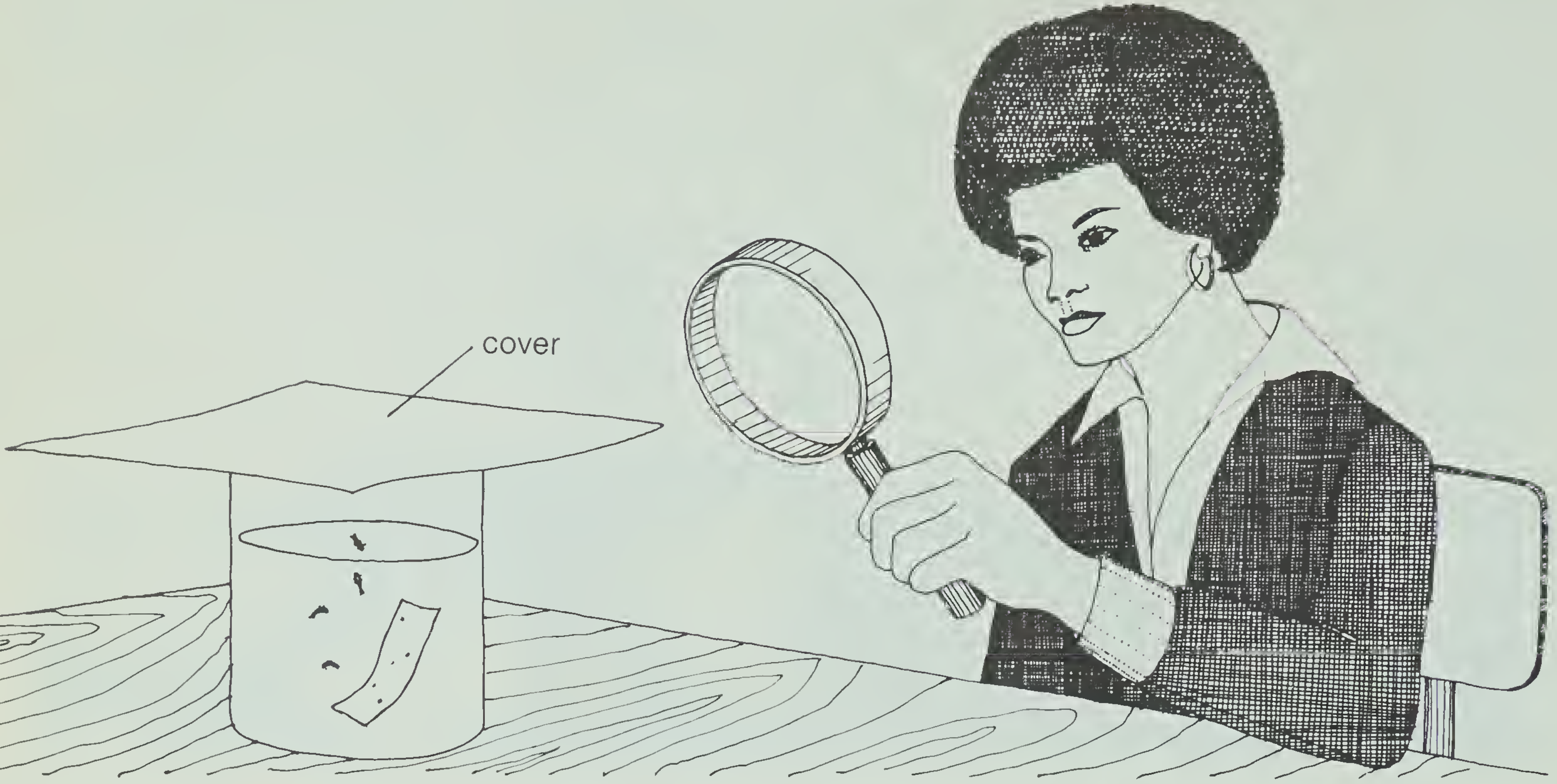


PART 4: ADULT MOSQUITOES

About 10 days after you have begun this activity, the first adults should begin to hatch out. In warm weather this may take less time, in cold weather more. To see the mosquitoes hatch out, you'll need the following items:

mosquito cage from Part 3
piece of cardboard or glass
hand lens

Use a small piece of cardboard or glass to cover the beaker as you remove it from your cage. Use a hand lens to watch the adults emerge from their pupae. If your pupae are not hatching, check other sets around the classroom.



✓ 2–10. How does the adult emerge from the pupa shell?

2-10. Adult comes out of the upper part of the pupa, with wings folded and legs folded to its sides.

✓ 2–11. The adult can't fly until its wings dry out. How does the adult dry its wings?

2-11. Adult stands on the surface of the water — then the sides of the beaker - and fans its wings to dry them.

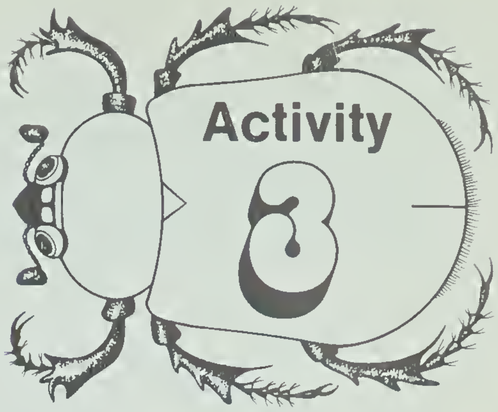
✓ 2–12. What happens to the pupa shell after the adult emerges? 2-12. Pupa shell remains afloat on the water.

Mosquito eggs are large compared to the size of the adult female. This is because the egg is full of food for the growing embryo.

Blood is needed to lay eggs. Both male and female mosquitoes can live on flower nectar, but the female of most kinds of mosquitoes needs blood meals to lay eggs. So, when you're bitten, you know it's a female mosquito.

ACTIVITY EMPHASIS: A description of the life cycles of insects which undergo gradual and complete metamorphosis.

Growing in Armor



MATERIALS FOR STUDENT UNIT
None.

Have you ever looked at an insect that has smashed into the windshield of a car? You'd find that it is made up of an outside shell and a big splash. Insects, spiders, and other bugs all have a soft, boneless body inside a tough outer skeleton.

Figure 3–1 shows a cutaway view of a grasshopper. The outer skeleton is like a suit of armor. The muscles are attached to it. The skeleton is made of a substance that is lightweight and tough. It is also resistant to chemicals. In addition, the skeleton has a waxy surface that makes it waterproof. Not only does it keep wetness out of the animal's body but it also prevents the inside of the insect from drying out.

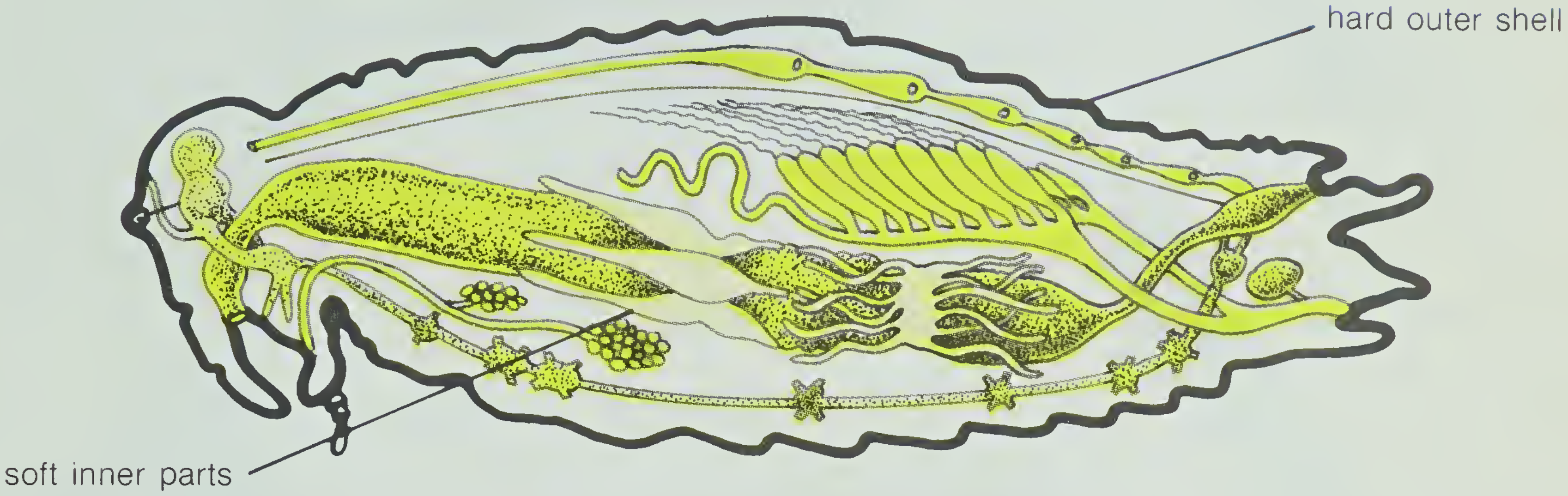
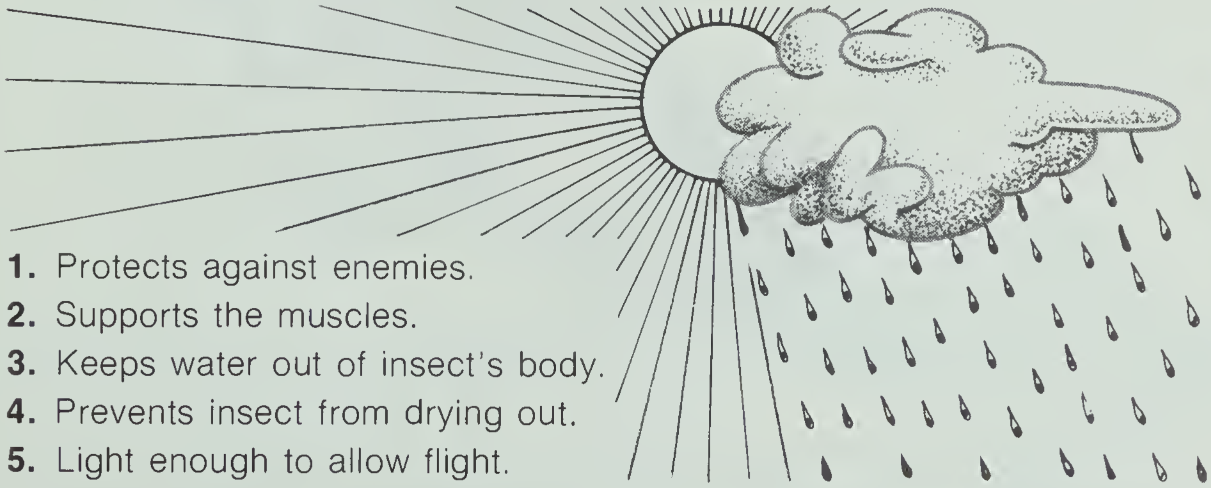


Figure 3–1

Insects are among the most successful animals on Earth. They can survive many different kinds of conditions. Figure 3–2 shows how the outer skeleton serves the animal.



1. Protects against enemies.
2. Supports the muscles.
3. Keeps water out of insect's body.
4. Prevents insect from drying out.
5. Light enough to allow flight.

Figure 3–2

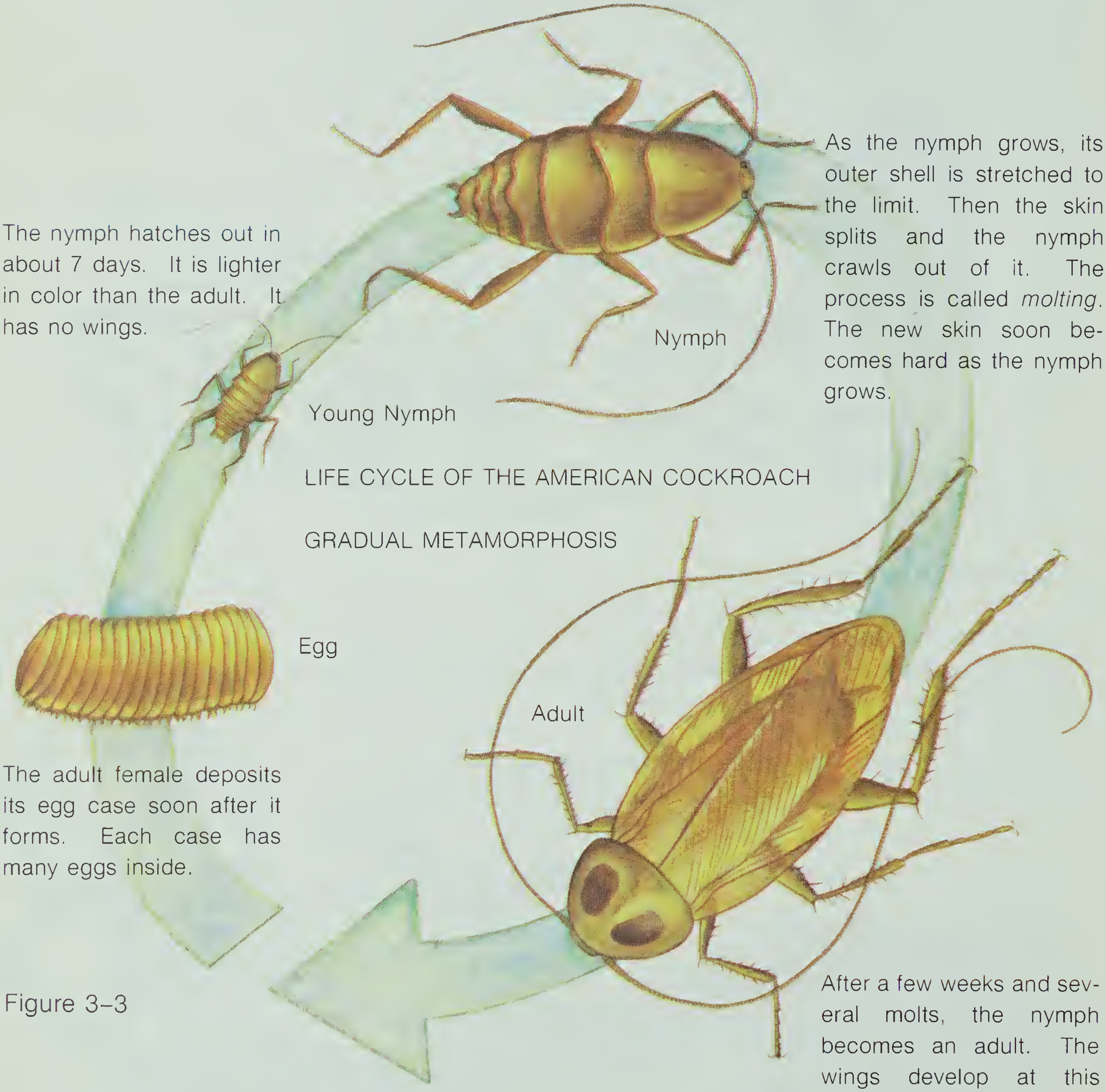
3-1 Protects insect from enemies; supports muscles; keeps water from entering body; prevents too much water from leaving body; light enough to allow flight.

✓ 3–1. What are some of the ways a hard outer shell helps an insect survive?

Students will need to refer to Figure 3-5 on page 16 to answer questions.

The outer skeleton presents a problem in growing. The skeleton can't stretch very much, certainly not enough to allow the animal to grow to adulthood. It's as if the animal were placed at birth in a tight-fitting suit of armor. How, then, does it grow?

The problem is solved in several ways. Two of these solutions are shown in Figures 3–3 and 3–5.



As the nymph grows, its outer shell is stretched to the limit. Then the skin splits and the nymph crawls out of it. The process is called *molting*. The new skin soon becomes hard as the nymph grows.

The nymph hatches out in about 7 days. It is lighter in color than the adult. It has no wings.

The adult female deposits its egg case soon after it forms. Each case has many eggs inside.

After a few weeks and several molts, the nymph becomes an adult. The wings develop at this stage.

Figure 3–3

✓ 3–2. Look at Figure 3–3. What are some of the characteristics of the nymph of a cockroach? 3-2. Nymph is smaller and lighter in color than the adult. Nymph is also not as well developed.

✓ 3–3. At what stage in the life cycle do the wings appear?
3-3. The adult stage.

Cockroaches — like all the bugs shown in Figure 3–4 — have young that look like the adults. The hard outer skeleton splits open as the animal grows. The animal grows continuously, with spurts of growth after each shedding of the skeleton. This kind of change is called *gradual metamorphosis*.

Refer to Figure 3–5 (next page) to answer these questions.

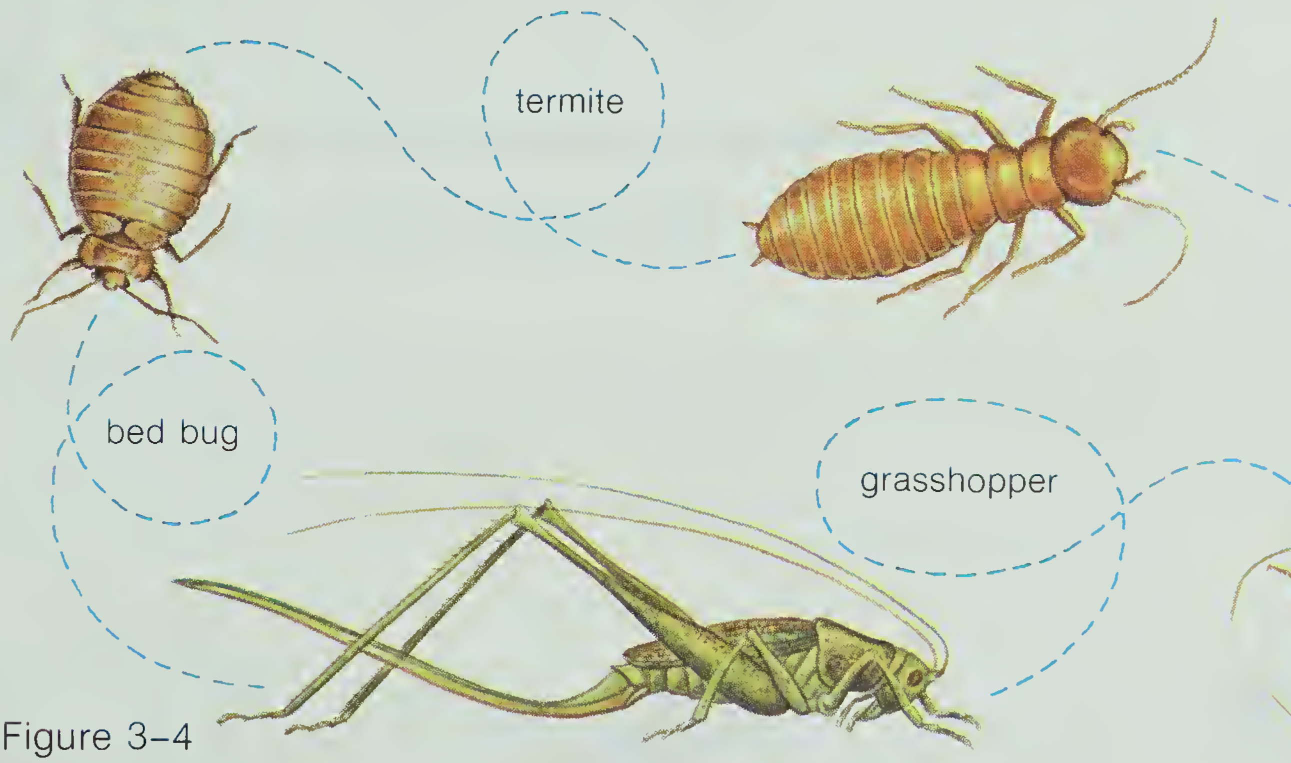
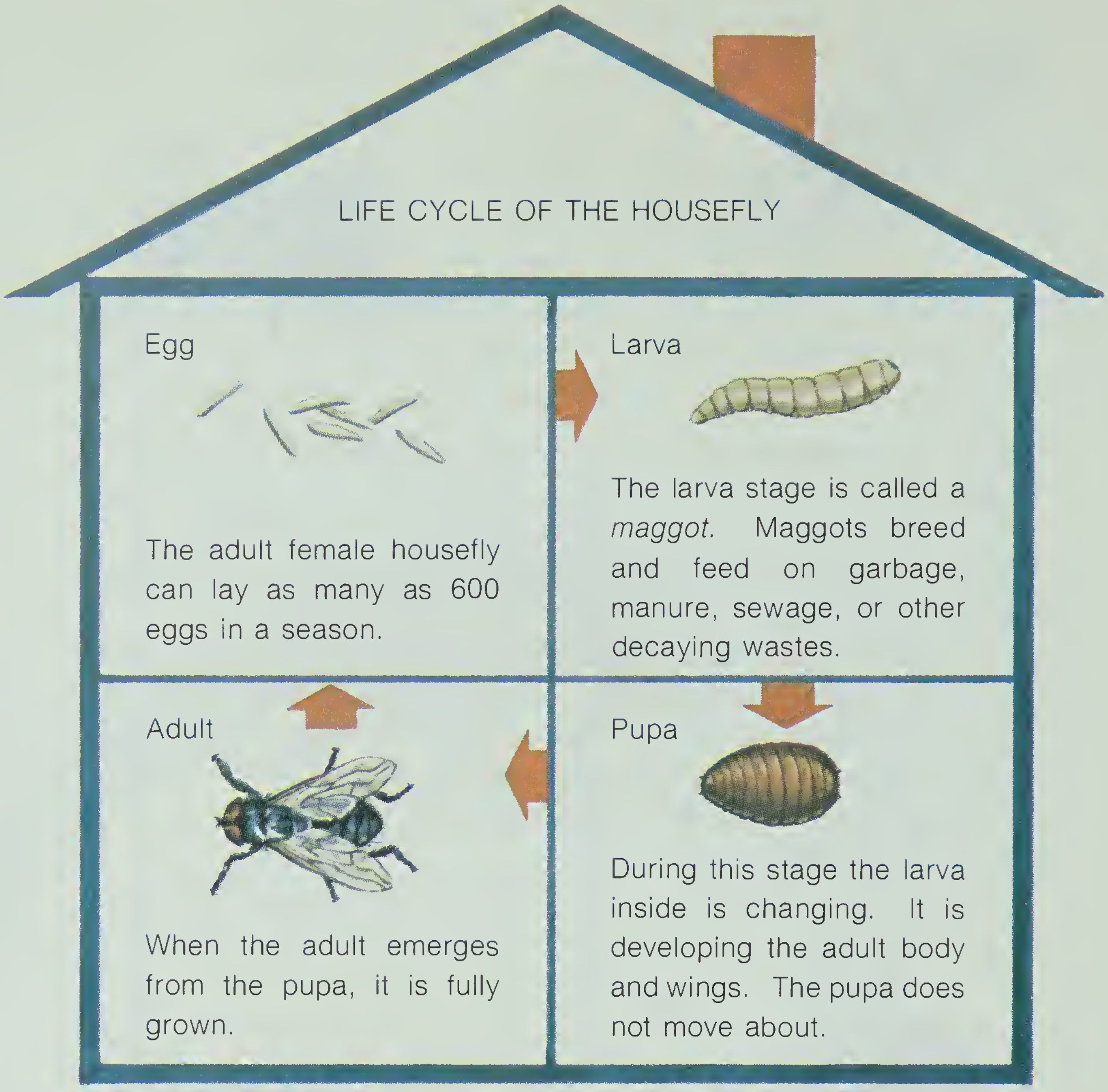


Figure 3–4

✓ 3–4. At what stages of its life cycle does the housefly eat?
3-4. Larva and adult stages.

★ 3–5. Suppose you found some very small flies in your house. Would these be young flies that are developing or would they be adults?

3-5. Adults.



The adult female housefly can lay as many as 600 eggs in a season.

The larva stage is called a *maggot.* Maggots breed and feed on garbage, manure, sewage, or other decaying wastes.

During this stage the larva inside is changing. It is developing the adult body and wings. The pupa does not move about.

When the adult emerges from the pupa, it is fully grown.

COMPLETE METAMORPHOSIS

Figure 3–5

The housefly — and all the animals in Figure 3–6 — have young that are quite different from adults. The larvae are well-designed eating machines. About 87% of all insects develop in this four-stage life cycle. These animals undergo a change that is called *complete metamorphosis.*

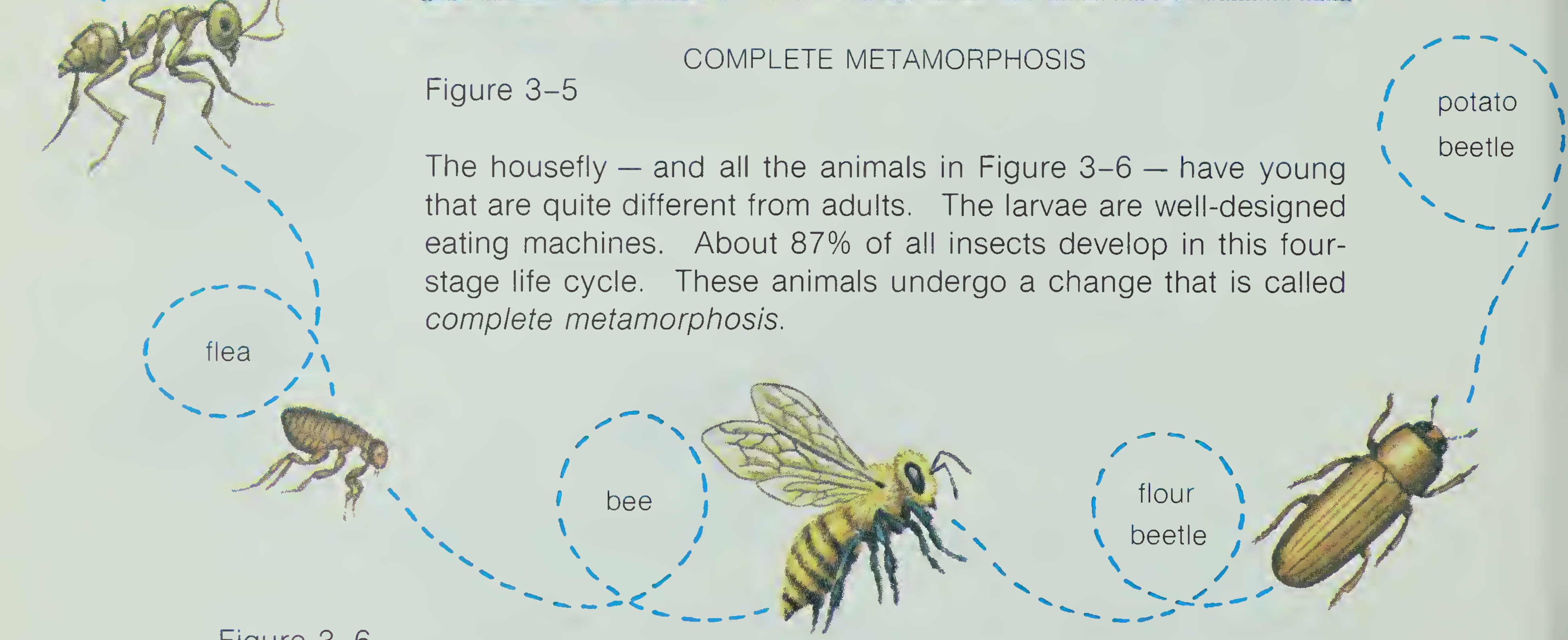
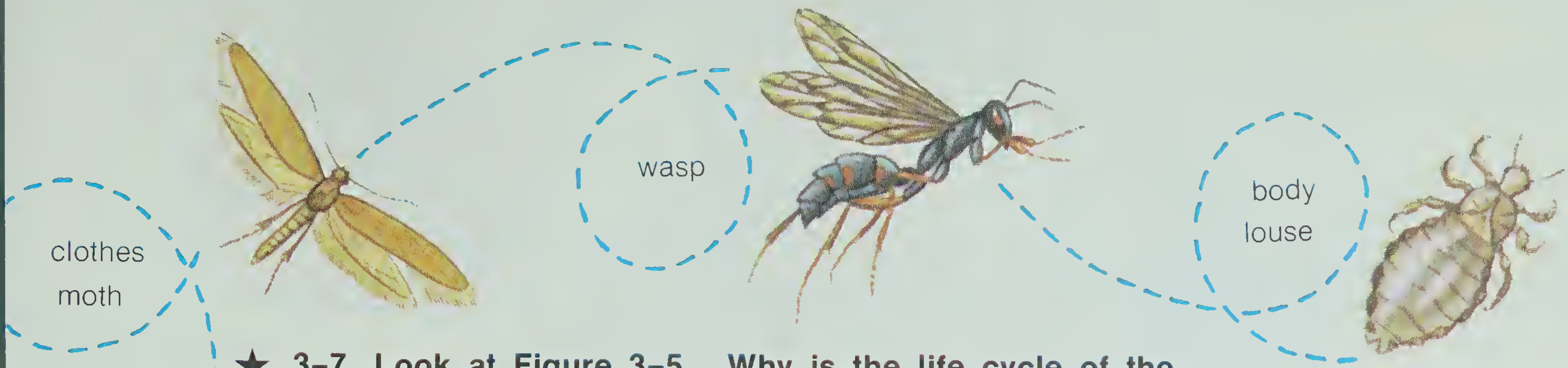


Figure 3–6

★ 3–6. How is gradual metamorphosis different from complete metamorphosis? 3-6. In gradual metamorphosis, the size of the insect changes but it remains similar in appearance. In complete metamorphosis, each stage looks entirely different.



★ **3–7. Look at Figure 3–5. Why is the life cycle of the housefly shown with four separate arrows, while the life cycle of the cockroach is shown with one continuous arrow?**

3-7. The separate arrows show that the housefly undergoes complete transformation from one form to another. The continuous arrow shows that the cockroach develops gradually from one stage to the next.

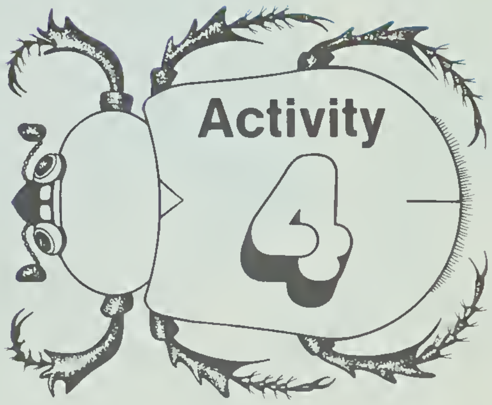
★ **3–8. How do insects like the cockroach grow from egg to adult?** 3-8. They periodically lose their external skeleton as they outgrow it.

★ **3–9. How do insects like houseflies grow from egg to adult?** 3-9. When they outgrow one form of existence they're completely transformed to another.

The pictures of many of the animals you've seen in this activity were the adult form. The adults of some insects like grasshoppers, ants, and beetles damage food crops. However, their larva and nymph forms can also be pests. Other activities in this minicourse will help you identify and control some of these pests in their larva, nymph, and adult stages.

ACTIVITY EMPHASIS: A description of how the pepper moth in England adapted to changes in its environment through the process of natural selection.

Messing with Nature



In only a few weeks an insect can live its whole lifetime. It grows into an adult. It eats. It wards off enemies. And it reproduces in large numbers. Sometimes its survival is threatened by nature. Bad weather is such a threat. Some insects can survive very cold weather by remaining in the pupa stage until the cold "blows over." Many insects die. But weather alone does not keep insect populations down.

This activity deals with a fascinating story of population control. The story really happened. It was even reported in newspapers and magazines. To do the activity, you will need the following items:

cassette tape for *Know the Bug, Activity 4*
cassette tape player

MATERIALS PER STUDENT UNIT
cassette tape for *Know the Bug*
cassette player, preferably with headphones

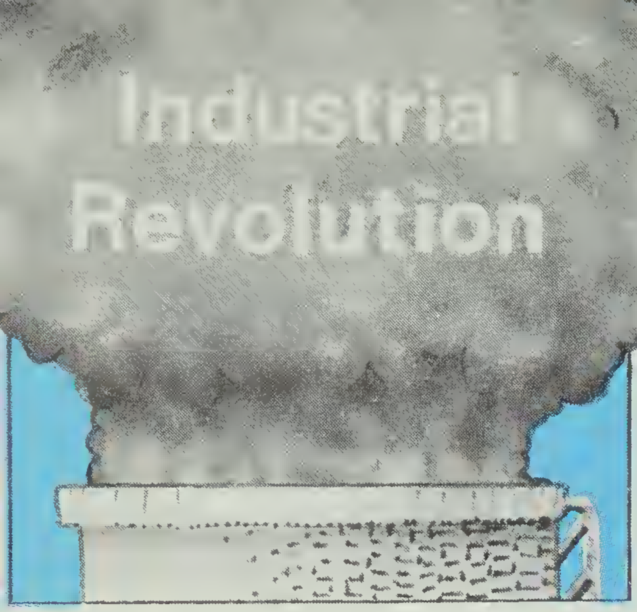


Figure 4–1

Figure 4–2

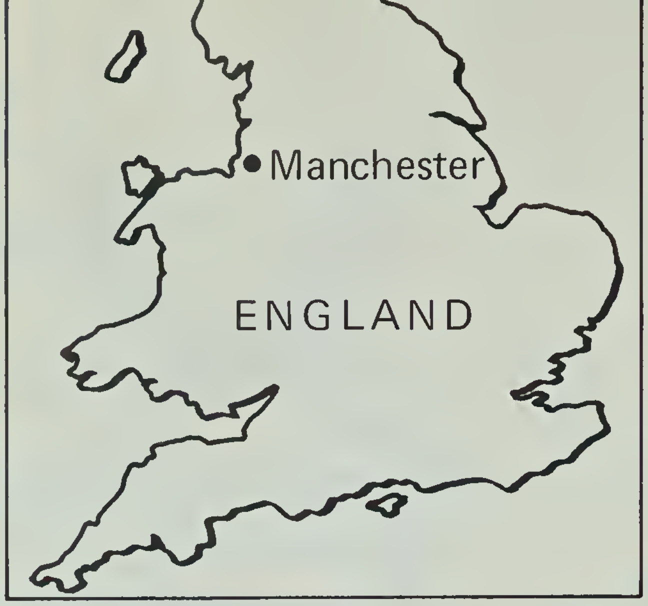


Figure 4–3

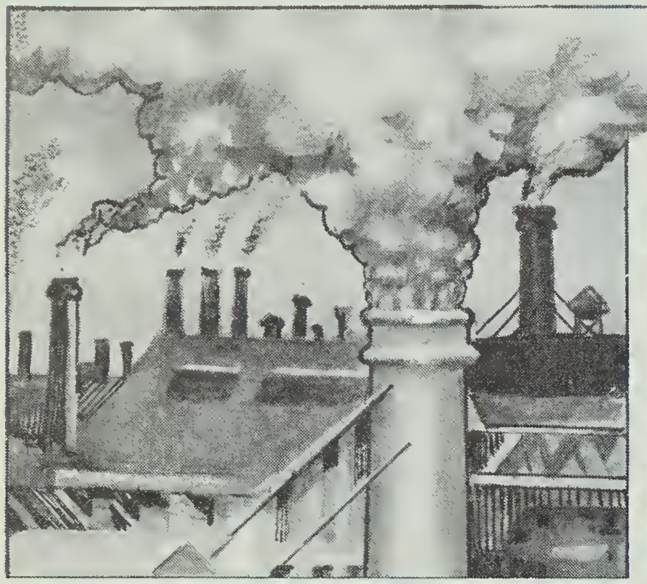


Figure 4–4

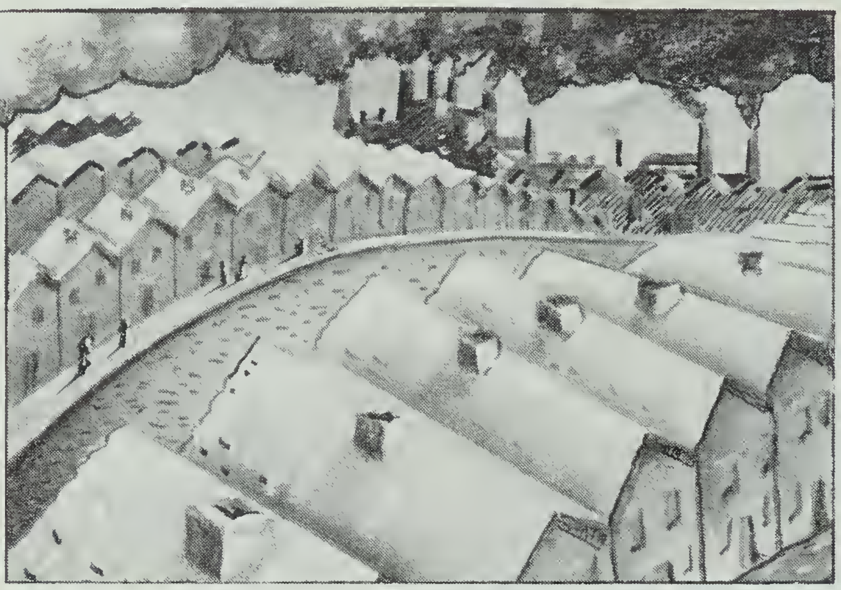


Figure 4–5

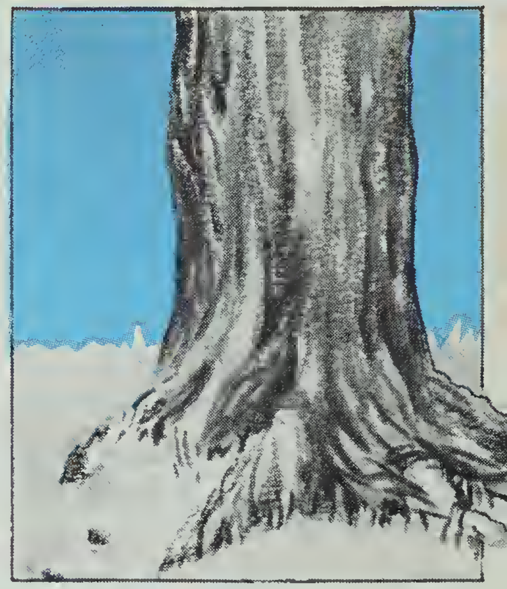


Figure 4–6

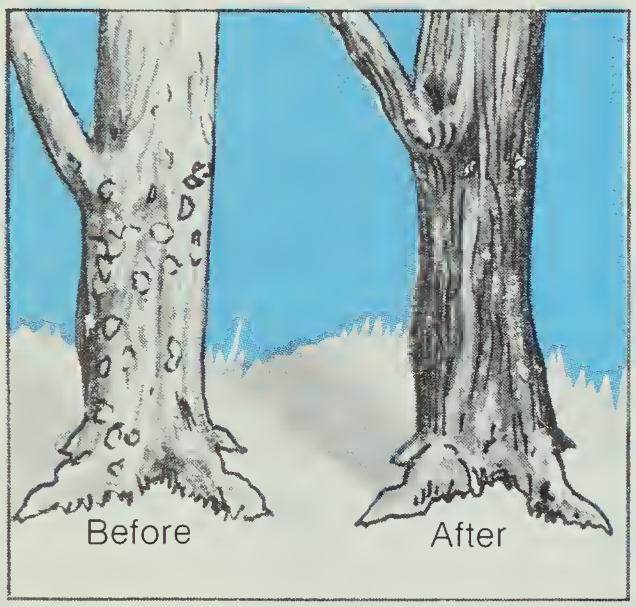


Figure 4–7

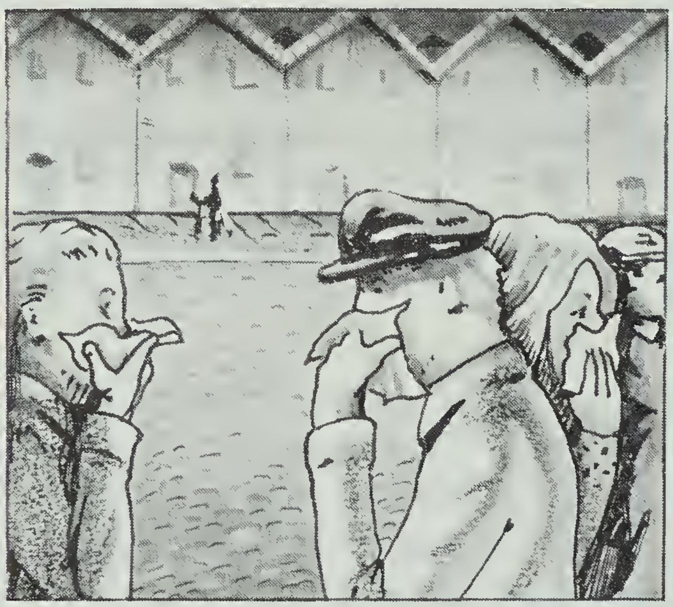


Figure 4–8

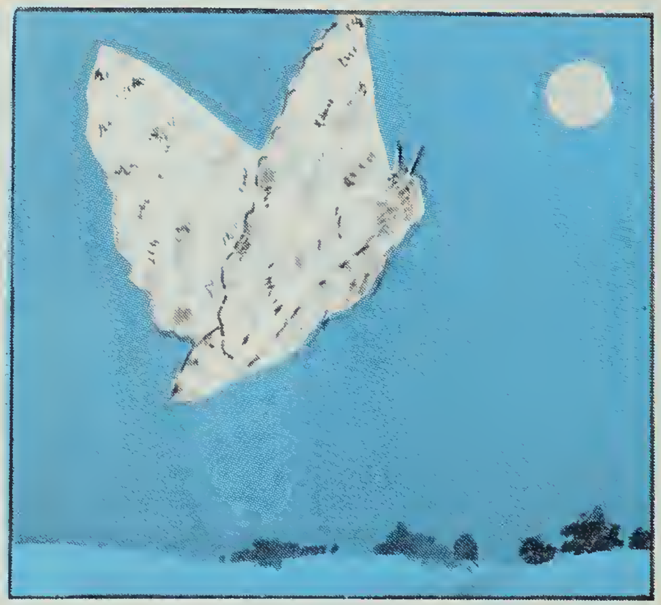


Figure 4–9

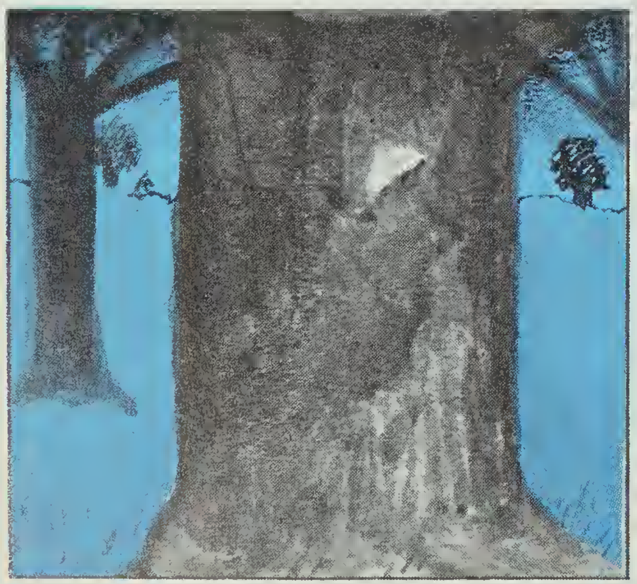


Figure 4–10

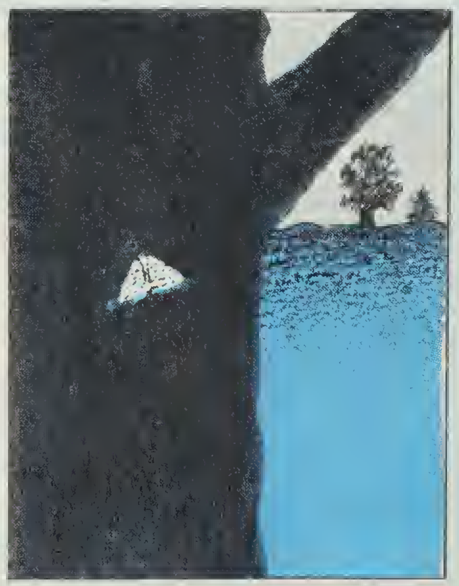


Figure 4–11

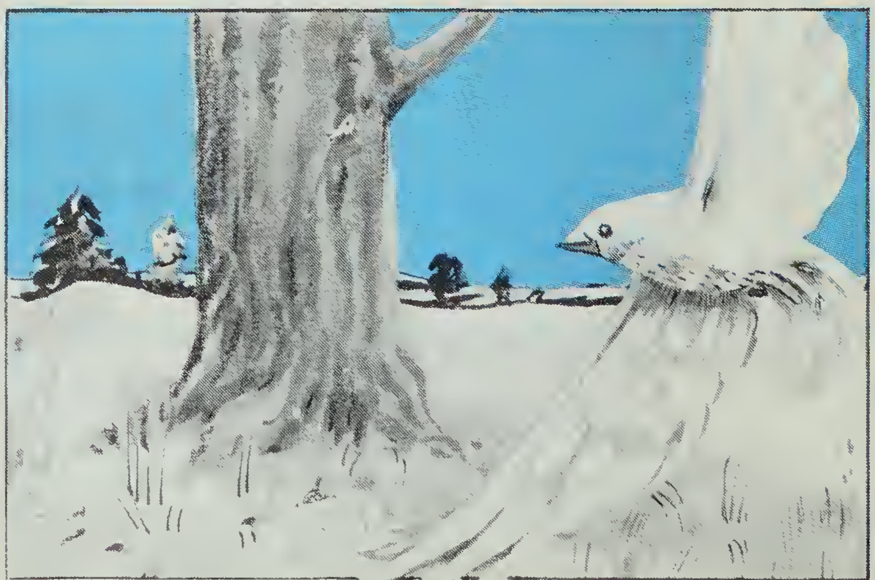
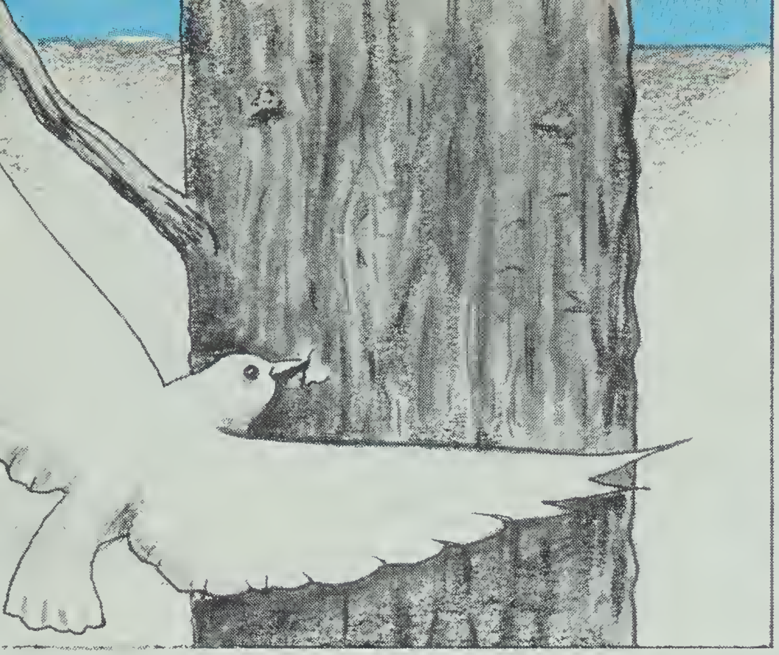


Figure 4–12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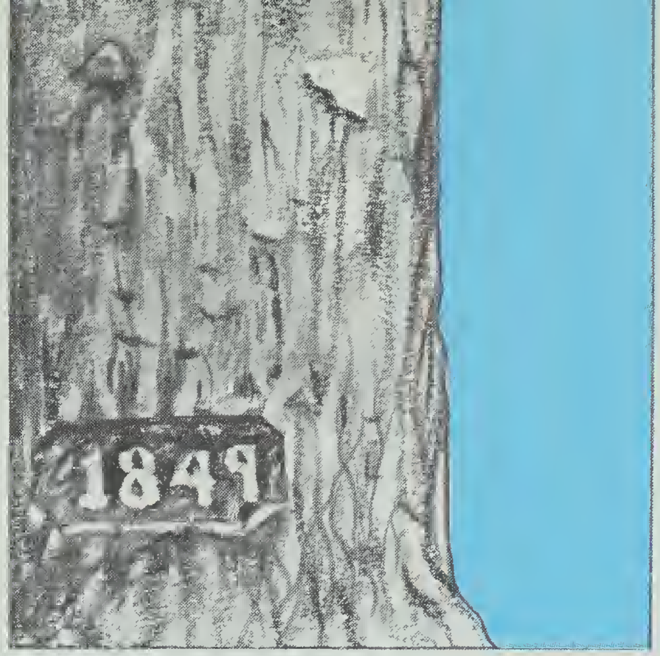
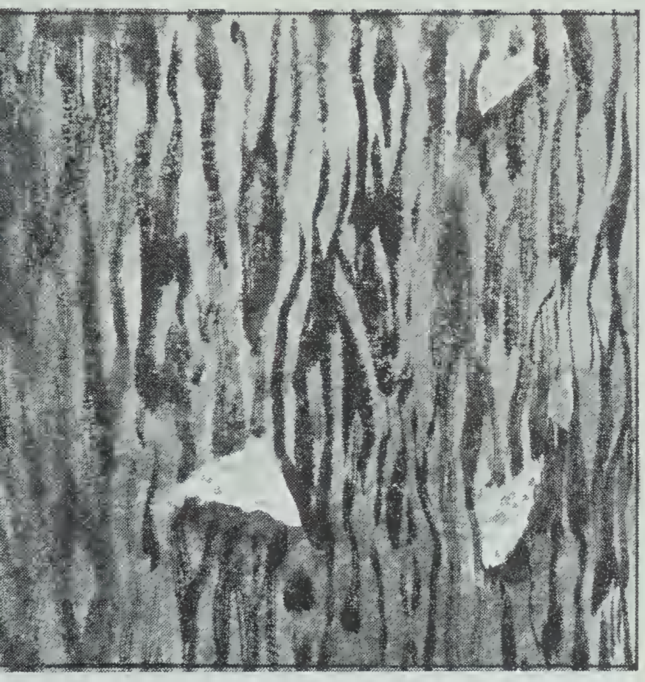


Figure 4–14

Figure 4–15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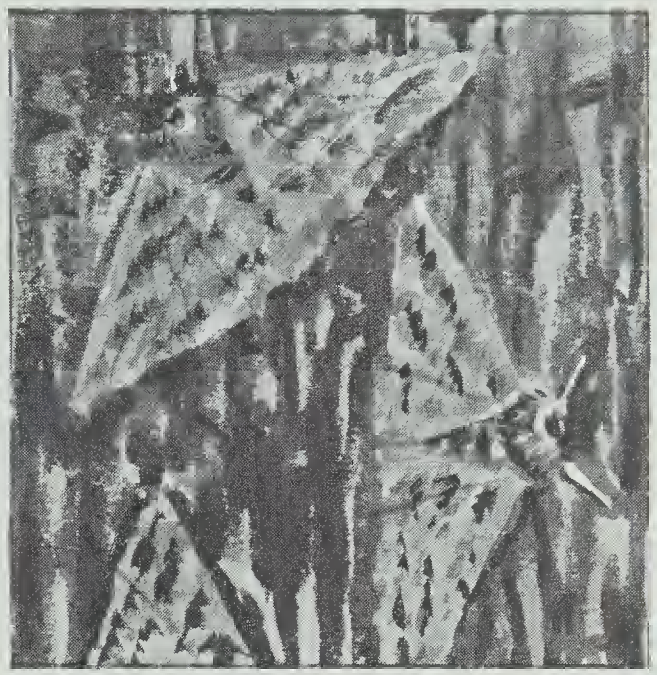


Figure 4–17

continued

Listen to Part 1 of the tape. While you are listening, look at Figures 4–1 to 4–17. As you listen to the tape, you will hear a tone. This tone is a signal to move from one illustration to the next. When the tape tells you to do so, stop and answer the questions.

✓ 4–1. What caused the tree trunks near Manchester, England, to be blackened?

4-1. Soot from coal burned in factories and homes landed on the trees.

✓ 4–2. What caused fewer lichens to grow on tree trunks?

4-2. Soot killed most of the lichens.

★ 4–3. When the oak trees were light colored and had lichens on them, how did the lighter moth escape being eaten by birds?

4-3. The birds couldn't distinguish the lighter moth from the tree trunk. They had the same appearance.

✓ 4–4. When the oak trees became darkened from soot, why did the birds attack the lighter moth and not the darker one?

4-4. Birds could see the lighter moth against the background of the tree trunk. Birds could not see the darker moth, which had the same appearance as the tree trunk.

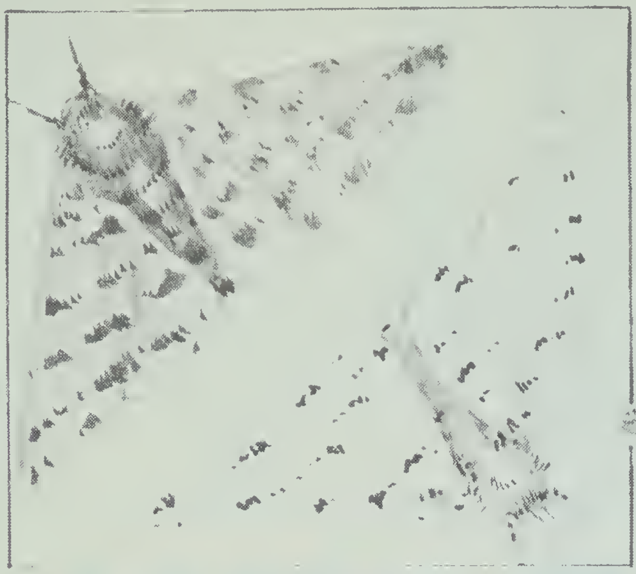


Figure 4–18

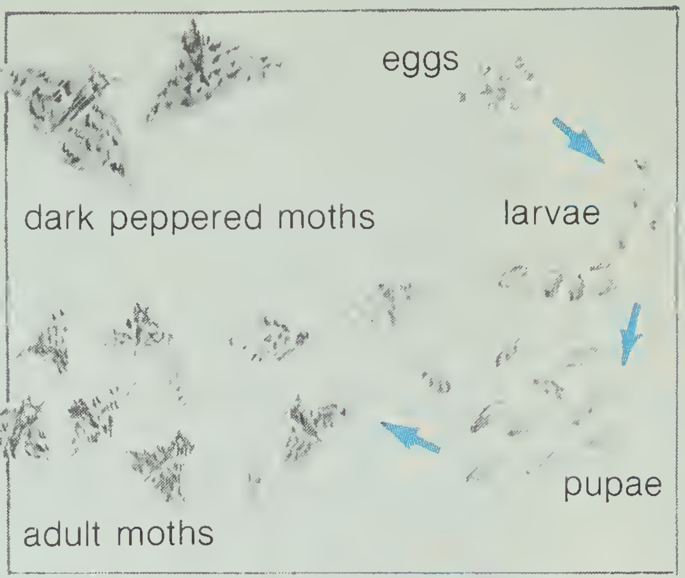


Figure 4–19

Figure 4–20

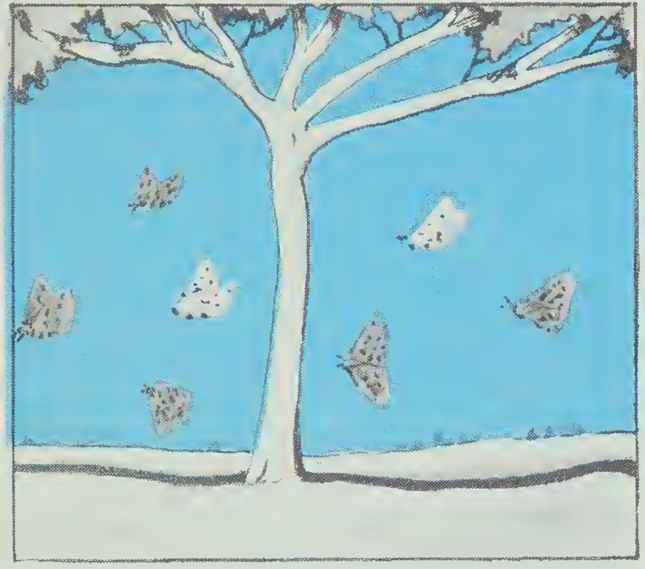
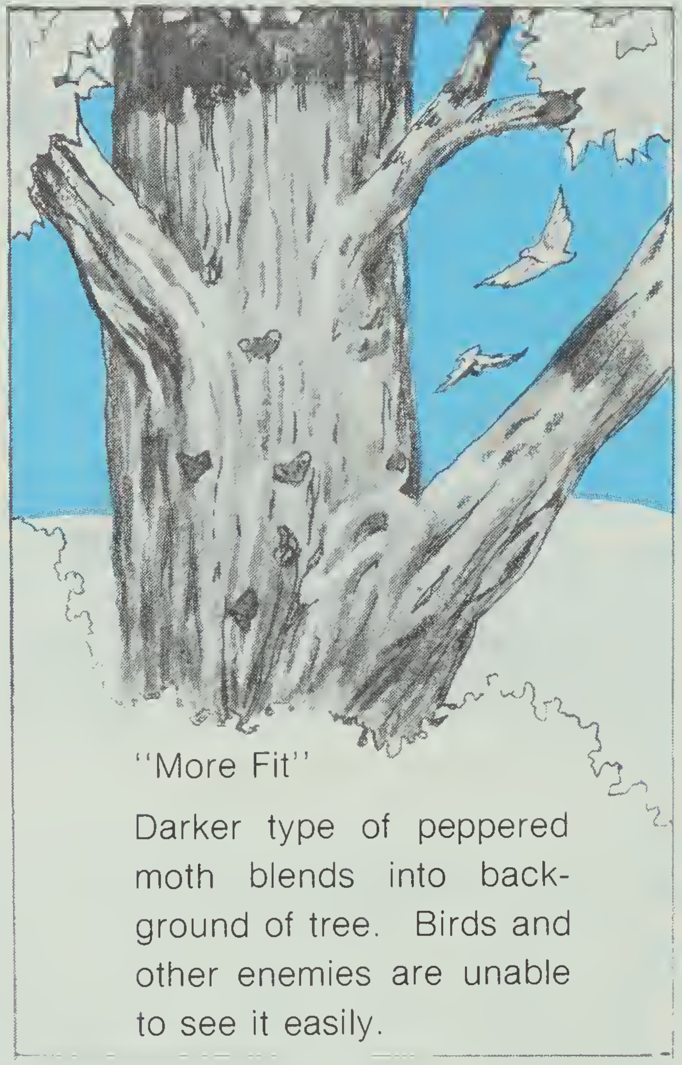


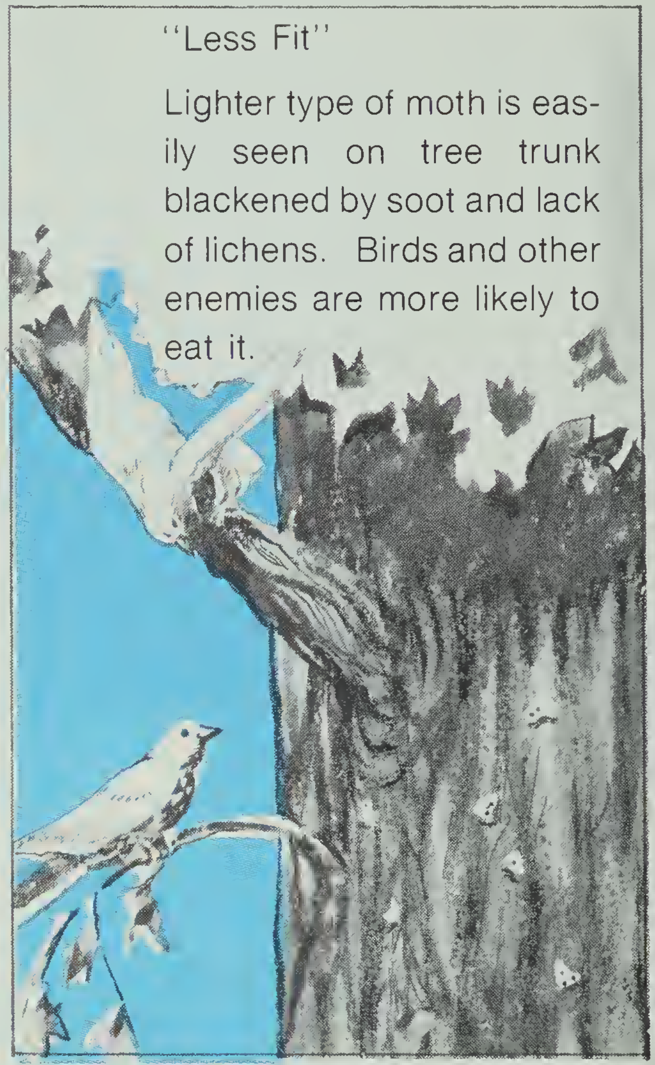
Figure 4–21



"More Fit"

Darker type of peppered moth blends into background of tree. Birds and other enemies are unable to see it easily.

Figure 4–22



"Less Fit"

Lighter type of moth is easily seen on tree trunk blackened by soot and lack of lichens. Birds and other enemies are more likely to eat it.

Figure 4–23

Now listen to Part 2 of the tape. As you listen, look at Figures 18 to 23. Again the tone will tell you when to move from one illustration to another. When the narrator tells you, answer Questions 4–5 and 4–6.

✓ 4–5. In the story of the dark and light-colored pepper moths, which moth was "more fit" to survive resting on tree trunks?

★ **4–6. The "more fit" animal should survive and produce more young that have its same characteristics. What happened in the story?**

4-5. During the years of heavy pollution, the dark moth was more fit. During the years of low pollution, the light moth was more fit.

4-6. Of every 10 offspring, 8 black moths and only 2 white ones were produced.

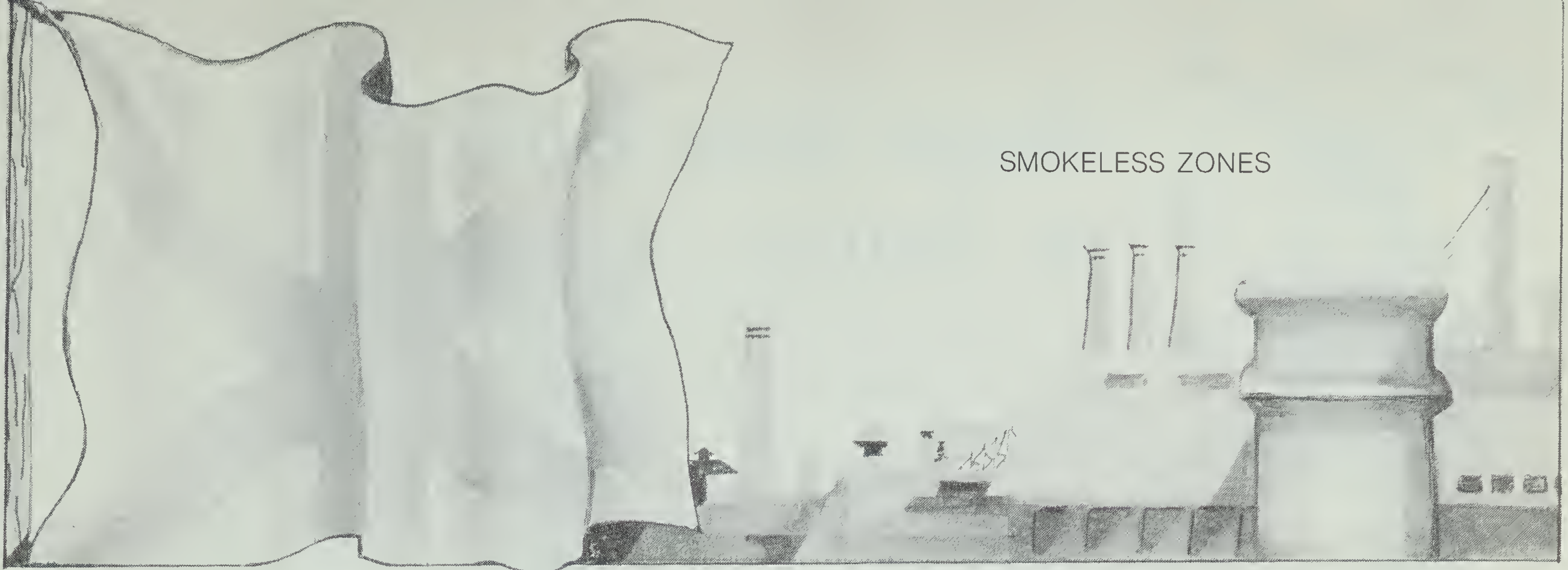


Figure 4–24

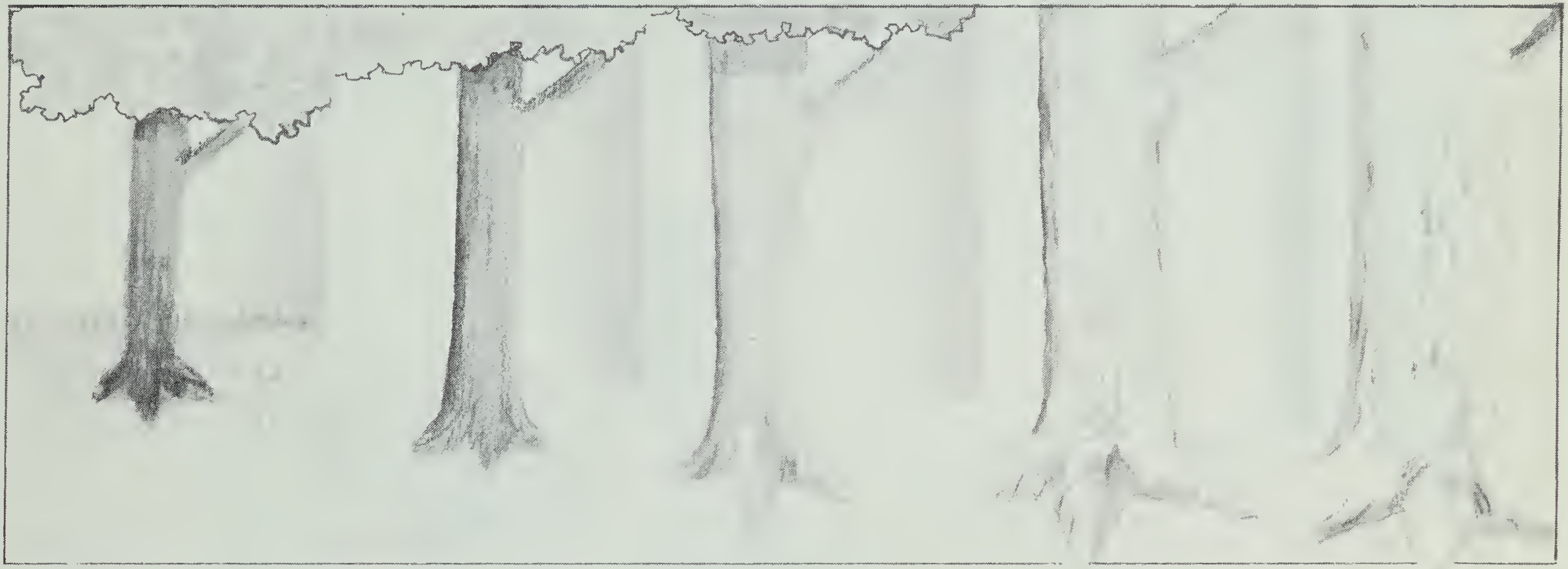


Figure 4–25

Now go back to the tape and listen to Part 3. While listening, look at Figures 24 and 25. Then answer Questions 4–7 to 4–10.

✓ 4–7. What is happening to the tree trunks now that air pollution near Manchester has dropped?

4-7. Tree trunks are becoming lighter in color and more covered with lichens.

✓ 4–8. Which moth can now escape more easily from being seen by birds?

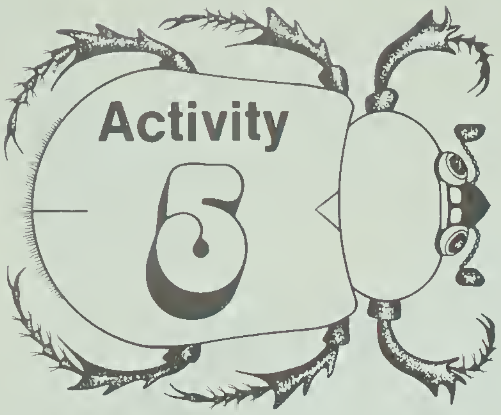
4-8. The lighter moth.

✓ 4–9. From what you hear on the tape, is the light-colored moth staging a comeback?

4-9. Yes, but slowly.

★ **4–10. How does the survival of the pepper moth illustrate natural selection?**

4-10. The darker moths were more fit for one period; the lighter moths for another. Thus the species of peppered moth could survive.



Activity 5

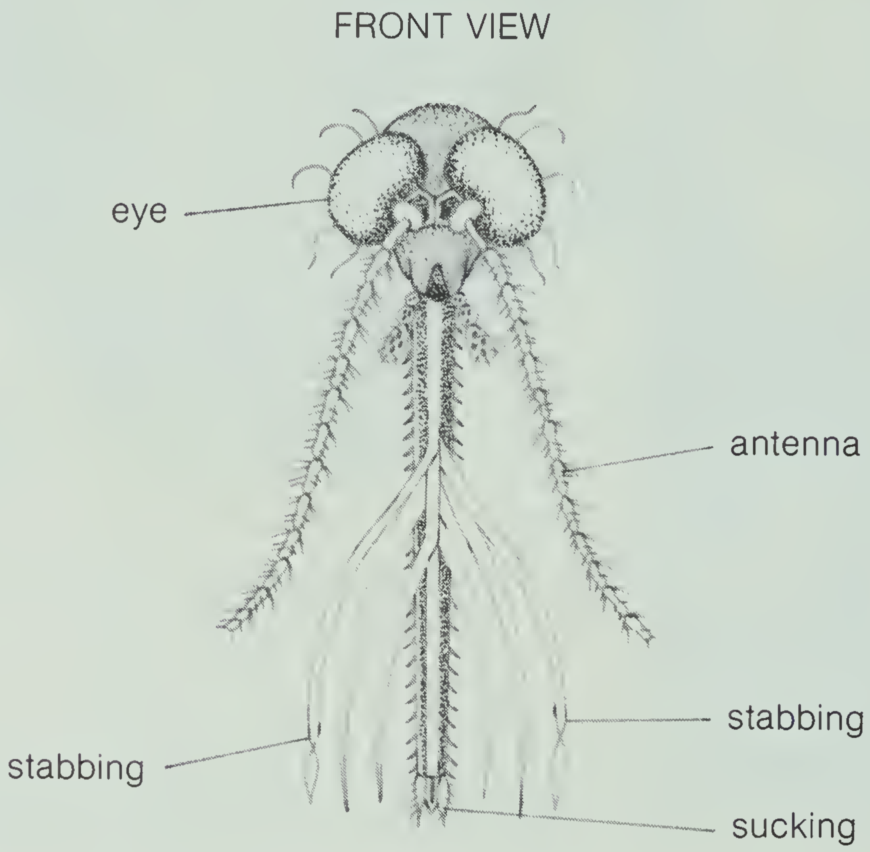
Bugs that Bite or Sting

ACTIVITY EMPHASIS: Identification of common biting and stinging insects, how they bite or sting, and how these bites and stings are treated.

If you've ever taken care of a vegetable garden, or a lawn, or shrubs, you know that bugs can be pests. Some feed on plants and destroy them. This activity, however, is about pests that sting and feed on people.

Bugs that bite or sting pierce your skin. They're usually after one thing — blood.

Figure 5–1 shows the mouth parts of a mosquito. Some mouth parts stab a hole in your skin as they bite. Other parts suck up the blood into their bodies.



The mouth parts of mosquitoes vary somewhat with the species.

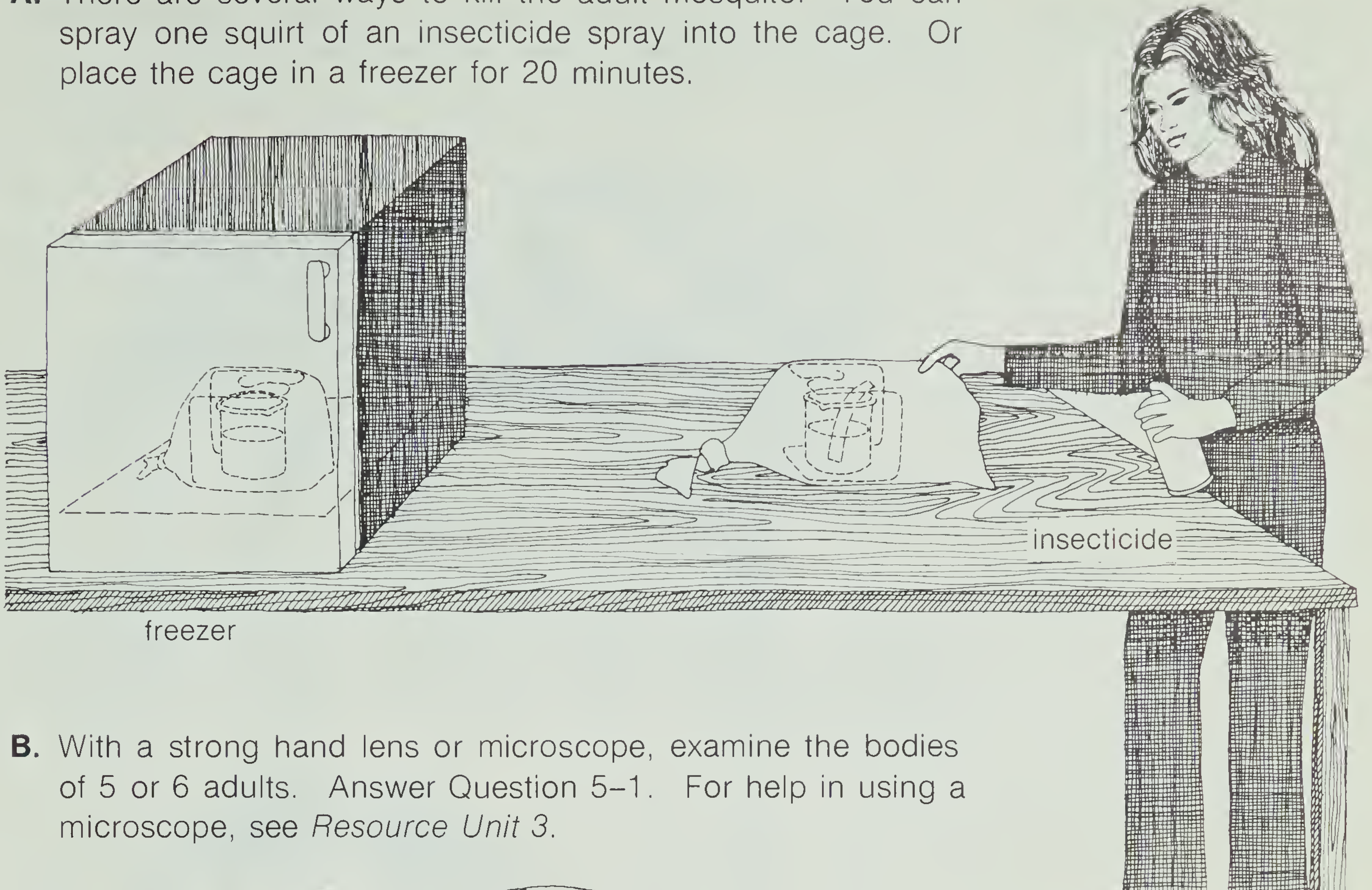
Figure 5–1

MATERIALS PER STUDENT UNIT
insect spray or freezer
lens, hand, or dissecting microscope

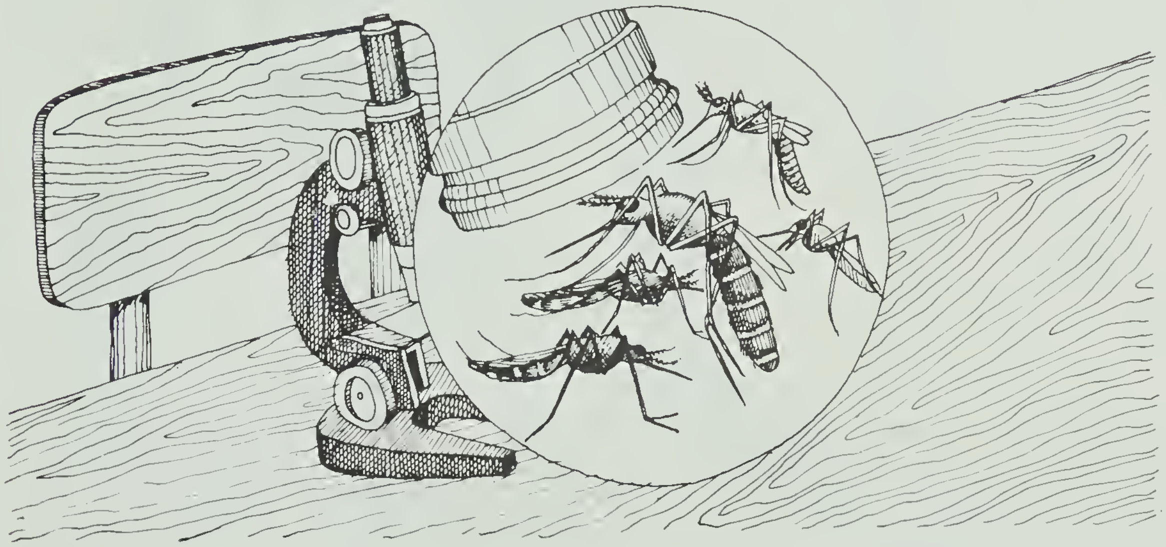
Observe the mouth parts of a mosquito. First you'll need to kill and examine several adult mosquitoes. You'll need the following:

adult mosquitoes from Activity 2
insect spray or freezer
strong hand lens or microscope and slide

A. There are several ways to kill the adult mosquito. You can spray one squirt of an insecticide spray into the cage. Or place the cage in a freezer for 20 minutes.



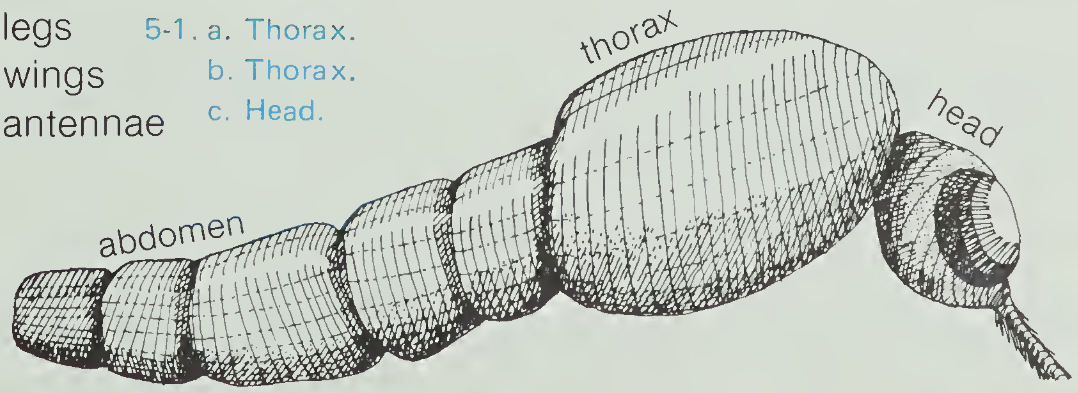
B. With a strong hand lens or microscope, examine the bodies of 5 or 6 adults. Answer Question 5-1. For help in using a microscope, see *Resource Unit 3*.



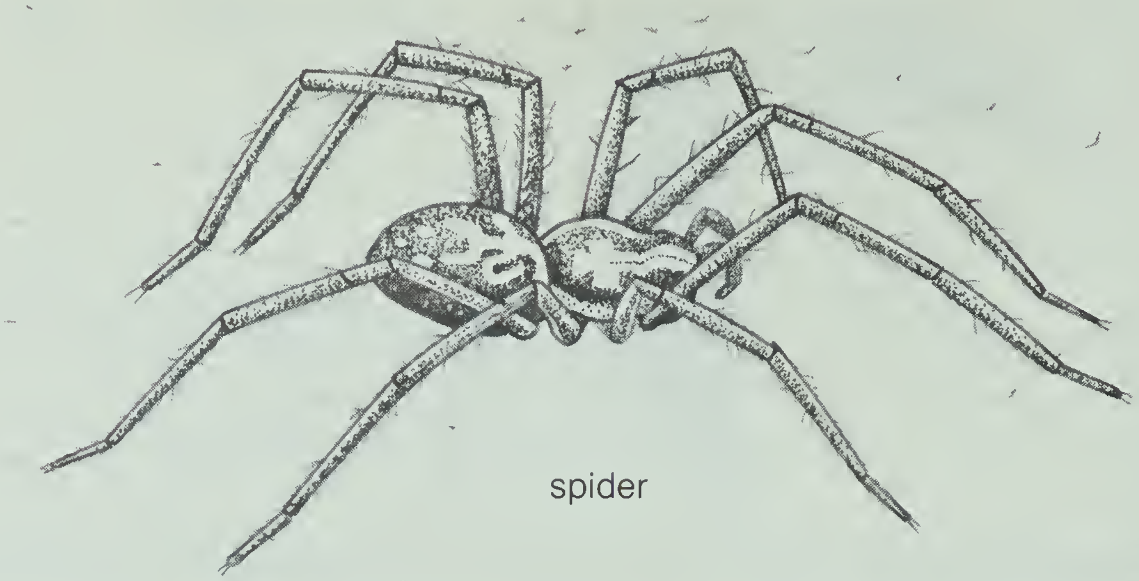
✓ 5-1. The body of the mosquito has three parts: head, thorax, and abdomen. To which part are the following attached?

a. legs
b. wings
c. antennae

5-1. a. Thorax.
b. Thorax.
c. Head.

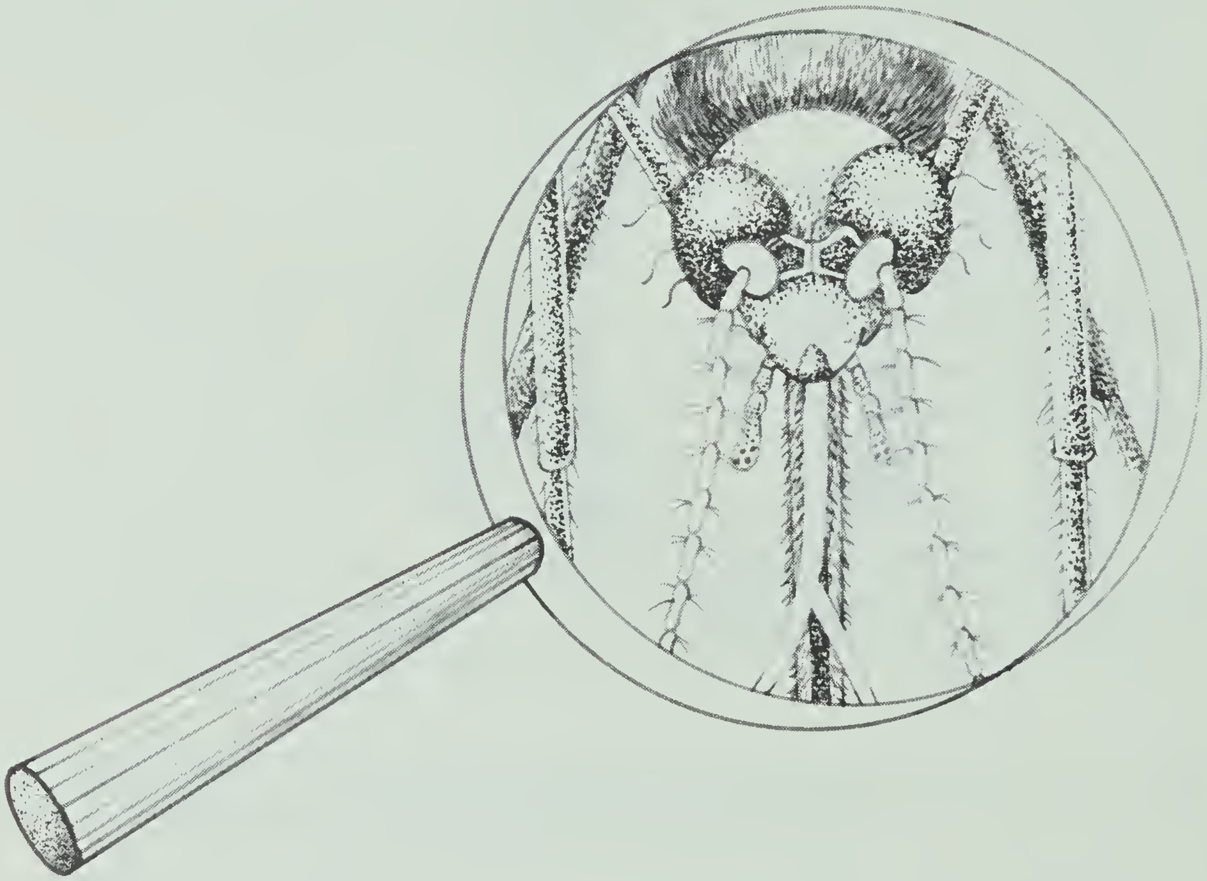


The mosquito is an insect. You can tell insects from other bugs because an insect has a three-part body and six legs.



spider

Spiders, on the other hand, are members of another class of bugs called arachnids [ah-RACK-nids]. Spiders have a two-part body and eight legs.



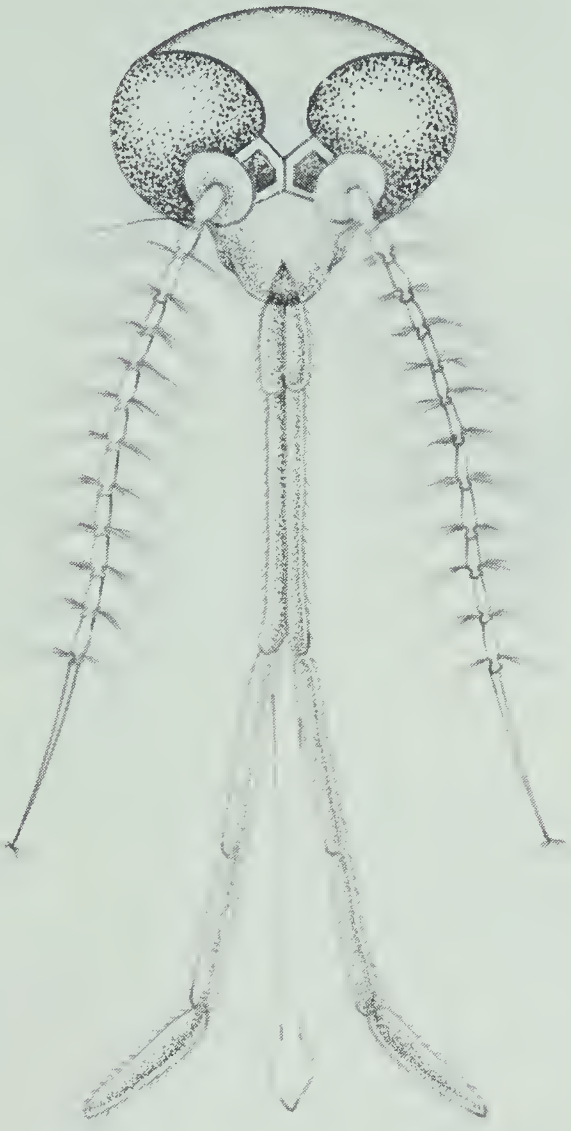
Look at several adult mosquitoes through a hand lens or under a dissecting microscope. Look carefully at the head parts. Answer the following questions.

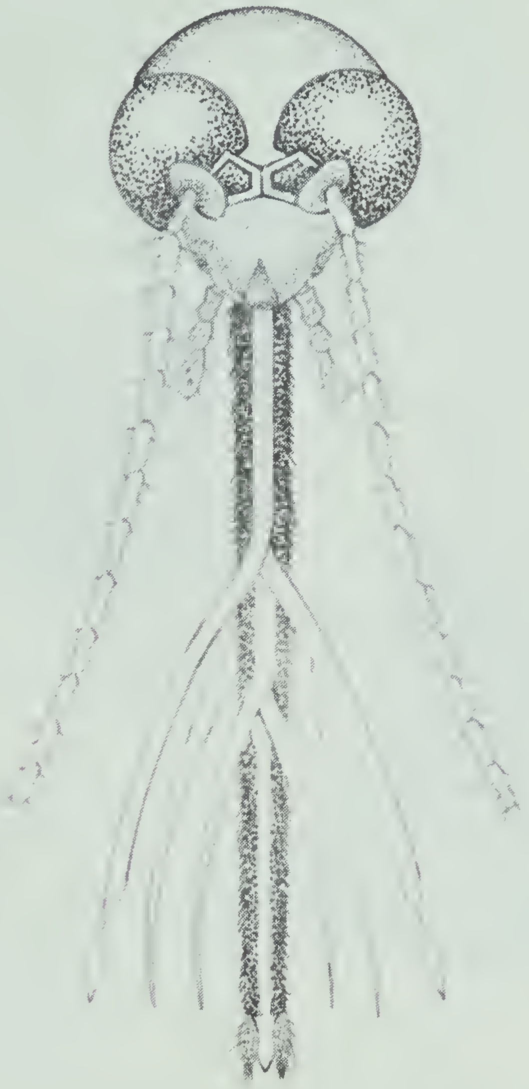
✓ 5–2. Notice the long tube at the front of the head. This tube is called a *proboscis*. It sucks up blood from animals or nectar from plants. How long is the proboscis compared with the length of the center section of the mosquito's body?

5-2. About the same length.

✓ 5–3. Note the two feelers, or antennae, on the head. The male mosquito has feathery antennae. The female's antennae have fewer hairs. Compare the proboscis of a male with that of a female. What are the differences, if any?

5-3. The male's proboscis is much shorter.


male


female

Female mosquitoes, not males, bite. In most species, the female must have blood before it can lay eggs. There are substances in the blood it needs. After pushing its proboscis through the skin of the person, it injects a small amount of anticlotting liquid to help the blood run freely. The female mosquito then draws the blood and anticlotting liquid back into its body.

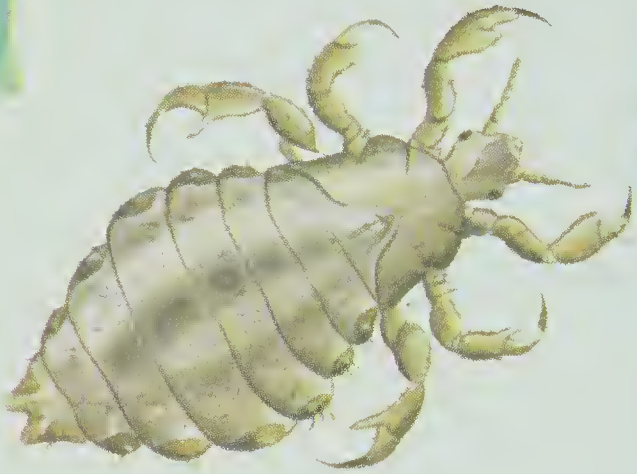
If disturbed, the mosquito may have to move from person to person to get enough blood. Here's the dangerous part. Some of the blood from one person may mix with the anticlotting liquid that gets sucked into the mosquito. This blood may be infected. The infected blood together with the anticlotting liquid can then be injected into the next victim.

✓ 5–4. How do you think mosquitoes transfer disease from person to person?

5-4. The mosquito injects one person's diseased blood into a healthy person. Any blood-carried disease can thereby be easily transmitted.

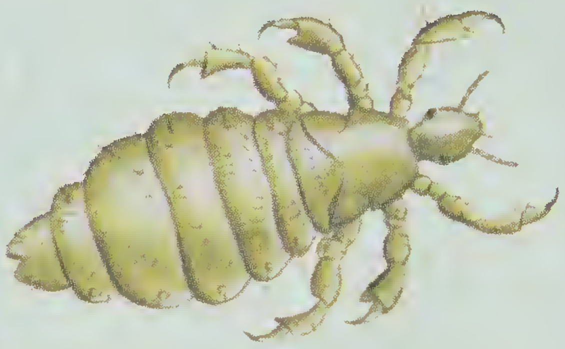
Figure 5–2 shows some pests that have one thing in common. Like the mosquito, they're all blood-sucking bugs that want to feed off people. Most of their bites hurt, swell, become red, and itch. They usually don't inject poisons into your body. But they *may* carry disease.

The bites of these pests can be treated with the soothing lotions used for sunburn. Lotions that contain a local anesthetic, such as benzocaine, can also be used. Ice or cold pack will reduce swelling. For an itch resulting from a bite, apply calamine lotion, first aid cream, or a soothing lotion.



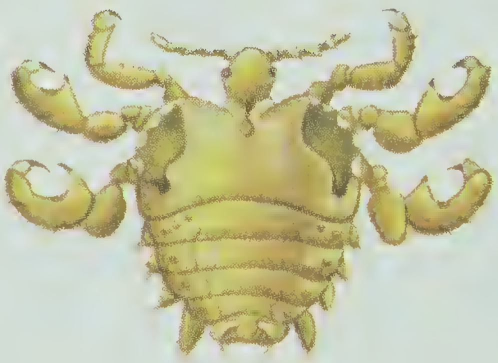
body louse*

The body louse hides in clothing when it is not feeding. Its bite causes a swelling much later. This pest can be found all over the body.



head louse*

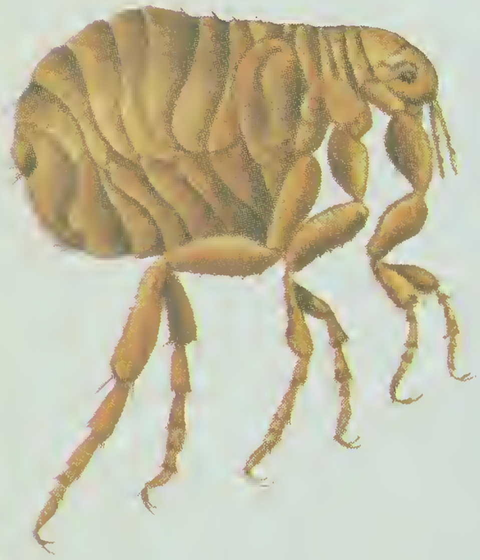
The head louse lives in the hair of the head, where it lays its eggs. Its bite is not painful, but later there will be a swelling.



crab louse*

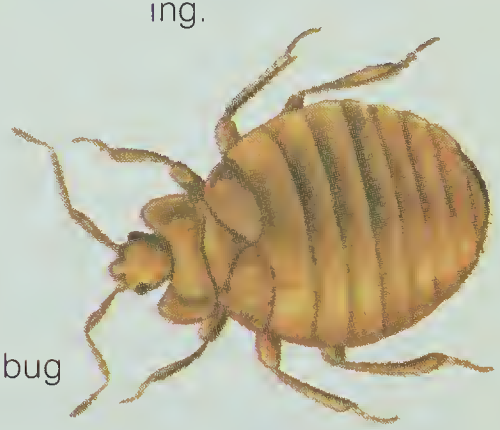
The crab louse lives in coarse hair under arms and around the genitals. Its bite causes itchy swelling.

*These lice are plentiful in unsanitary conditions. Kill lice by dusting body and clothing with contact insecticide. Clean up infected rooms. Call a professional exterminator or the local health department. Lice are carriers of typhus fever and other diseases. THEY CAN BE DANGEROUS!



flea

Fleas are usually carried to people by pets. Fleas can carry disease. Use a flea collar on a pet or dust the infected animal with powder. Clean rugs and furniture, then treat with insecticide.

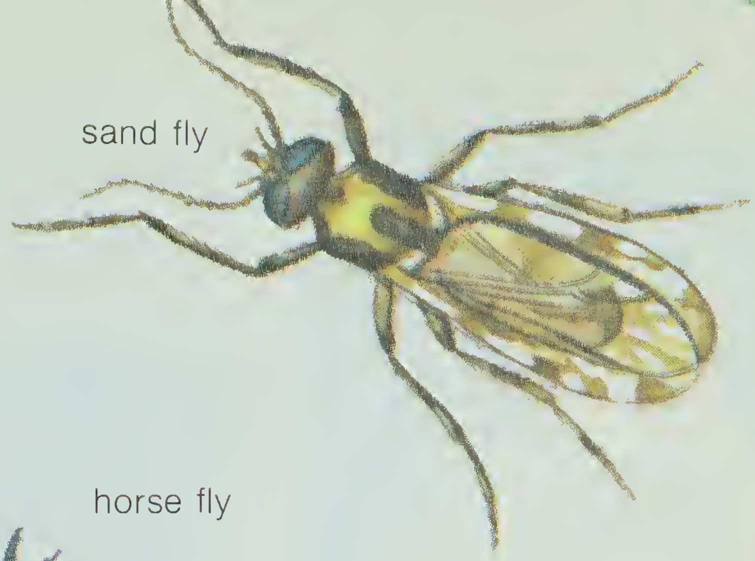


bed bug

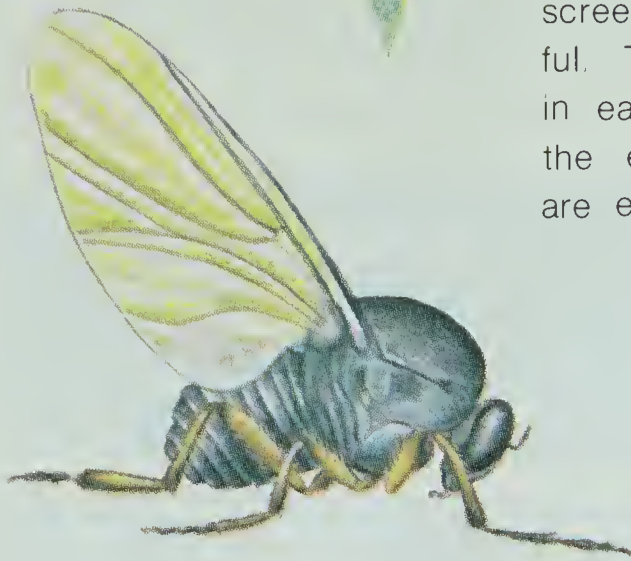
The bed bug is usually active at night. It hides in bedding, clothing, and furniture. Spray floors, walls, and furniture with contact insecticide.

Figure 5–2

The sand fly is very small — it can go through window screens. Its bite is painful. The sand fly is active in early morning and in the evening. Repellents are effective.

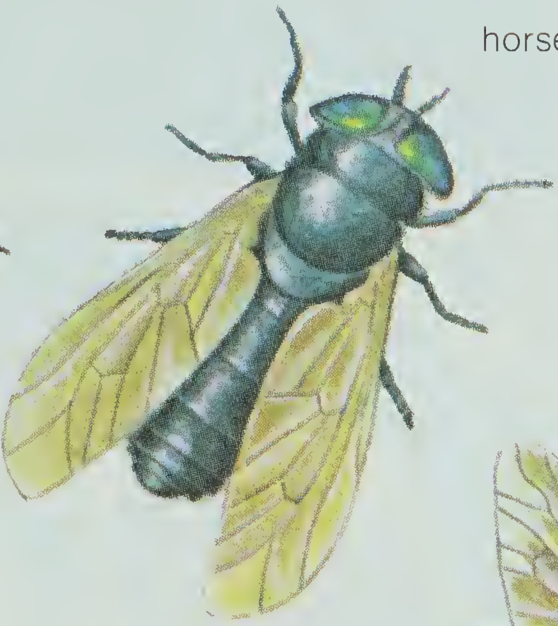


sand fly



black fly or buffalo gnat

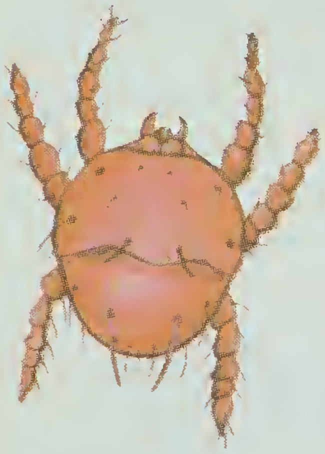
The black fly is found in wooded areas in late spring and summer. Repellents are effective.



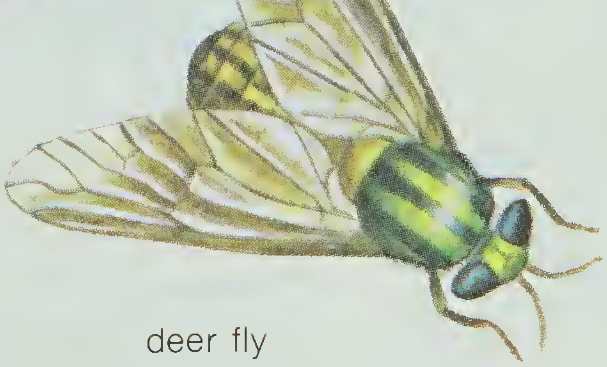
horse fly

The horse fly is active only in the daytime. Its bite is very painful. It is found around water and damp ground. Repellents are slightly effective.

chigger or red bug



The chigger crawls up the body to warm, moist areas or openings in clothing. Its bite causes redness and some swelling. Treat with soothing lotion. Spray clothing with repellent before going into grassy or brushy areas.

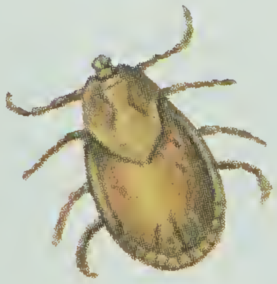


deer fly

The deer fly is similar to the horse fly. Its bite is painful. Repellents are effective for short periods of time.

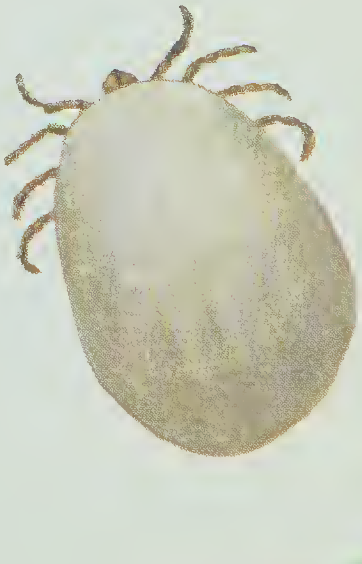
The tick is related to the spider. Some ticks transmit diseases, of which spotted fever is the most dangerous. The bite of some ticks can cause paralysis. Insect repellents will keep them off the body. Clothing and exposed skin should be sprayed.

tick



If you find a tick on yourself or on a pet, don't pull it out! Pulling it out leaves the head behind, which causes instant infection. Instead — apply alcohol or ammonia to the rear of the tick. The tick will release in several minutes. Then wash clothing. Spray yard with insecticide.

tick full of blood



WAYS TO AVOID HAVING THESE PESTS

- Clean up animal droppings.
- Put garbage into containers with tight-fitting lids.
- Clean up litter and trash.
- Have clean, sanitary conditions in the home.
- Plug up openings in woodwork, windowsills, and floors.
- Spray insecticides, but READ LABELS FIRST!
- Inspect pets regularly for pests.
- Inspect used furniture or clothing for adult bugs, nymphs, or eggs. Sterilize by boiling or throw away infected item.

✓ 5–5. What two things do all of the pests in Figure 5–2 have in common? 5-5. They are all nonpoisonous insects. But they are blood suckers.

✓ 5–6. Suppose one of the pests in Figure 5–2 bit you. How would you treat the bite if it was slightly swollen and sore?

5-6. Apply sunburn lotion and an ice pack. If the soreness remains, use calamine lotion.

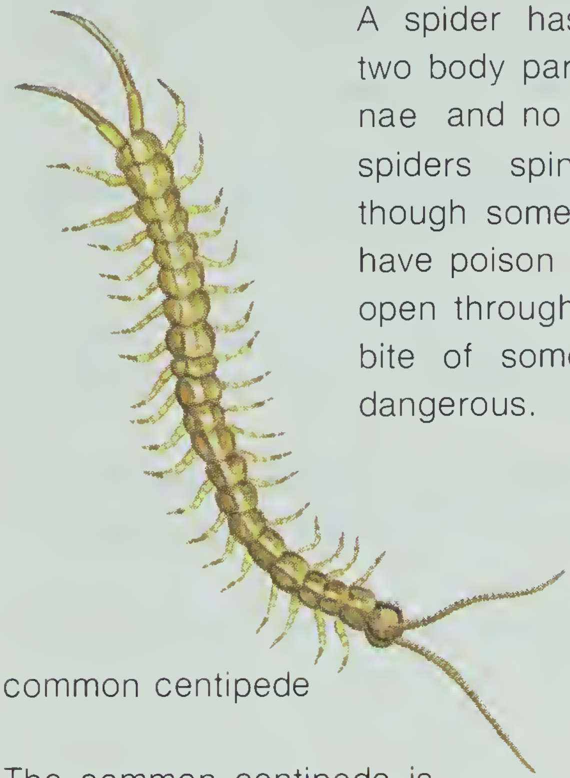
✓ 5–7. What kind of conditions in a house or apartment can lead to lice?

5-7. Lack of cleanliness. Garbage, trash, and animal droppings aren't removed immediately. Neither rooms nor people are kept clean.

✓ 5–8. What do lice, fleas, and ticks have in common that makes them dangerous to human health?

5-8. They can carry disease from person to person.

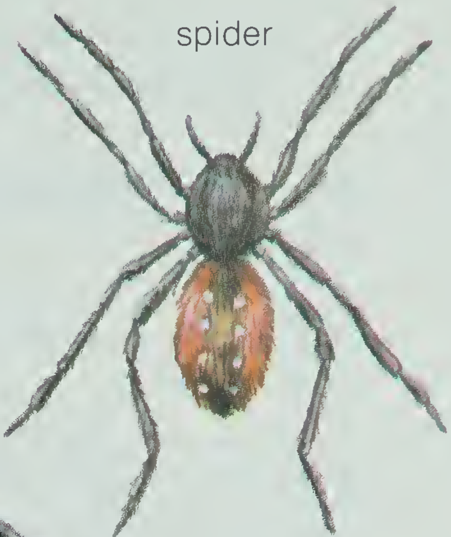
The bugs in Figure 5–3 are of another kind. They can give you a pretty nasty bite or sting if you disturb them by accident. Most of them also will inject poison into you that can cause pain, swelling, illness, and sometimes death.



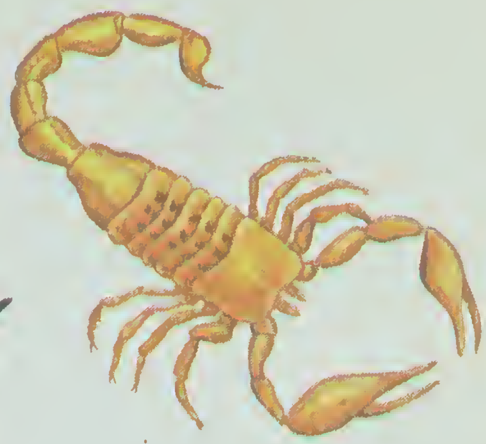
common centipede

The common centipede is usually found in houses. It feeds on other insects, usually at night. Its bite is rare, but painful. All centipedes have poison glands which open through their jaws.

A spider has eight legs, two body parts, no antennae and no wings. Most spiders spin webs, although some do not. All have poison glands which open through fangs. The bite of some species is dangerous.

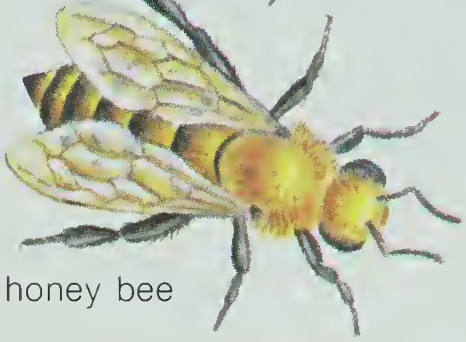


spider



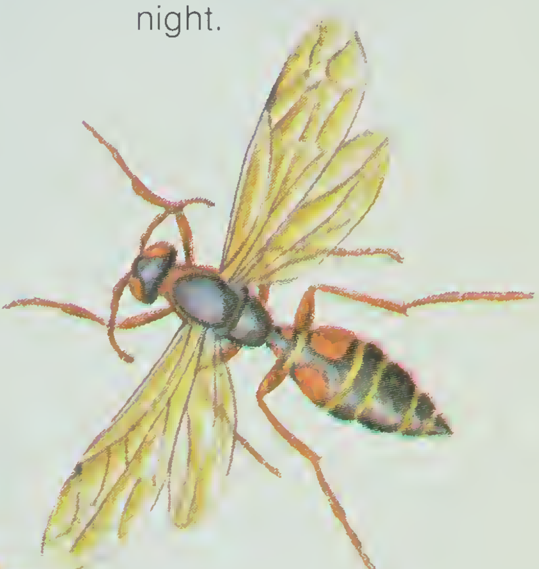
scorpion

A scorpion has pincers and a long tail with a stinger at the tip. It will sting if annoyed. Most scorpions live in warm, dry climates. They are found under rocks, old wood, or bark. Most scorpions feed at night.



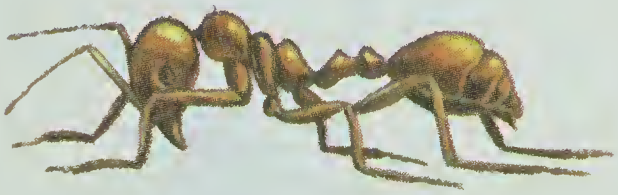
honey bee

Bees make nests underground or in hollow logs and trees. Bees generally do not sting unless bothered. The stinger is in the rear of the body.



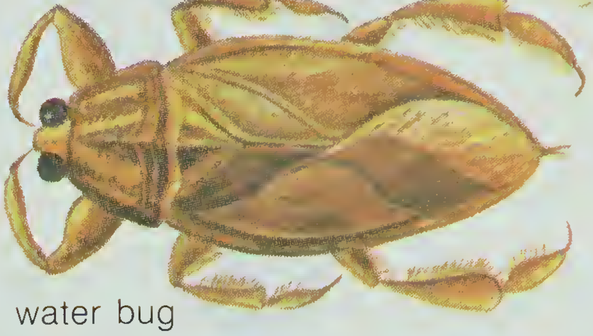
paper wasp

Paper wasps build their nest out of chewed-up wood and attach them under the eaves and to the walls of houses. Other wasps build clay or mud nests. Some build tunnels under the ground. The stinger in the rear of the animal injects the poison.



fire ant

The fire ant occurs in warm parts of the United States. Its sting is very painful. Fire ants have large mounds and often nest near buildings. They are aggressive when aroused. The stinger in the rear of the animal injects poison.



water bug

The water bug can be as large as 5 cm long. It prefers quiet water. Its bite is very painful and can produce painful swelling.

Figure 5–3

Most first aid treatments for the bites or stings of these animals aren't too effective. Apply a soothing lotion, such as that used for sunburn. Put ice on a swelling to bring it down.

Call a doctor if any of these things happen:
(1) fainting spells after bite or sting, (2) difficulty in breathing, (3) blurring of vision, (4) high fever, (5) paralysis of joint near bite. If in doubt, call a doctor anyway.

✓ 5–9. How do the centipede, water bug, and spider deliver their venom?

5-9. Through their mouth parts when they bite.

✓ 5–10. How do the scorpion, bee, wasp, and fire ant deliver their venom?

5-10. Through a stinger at the rear of the body.

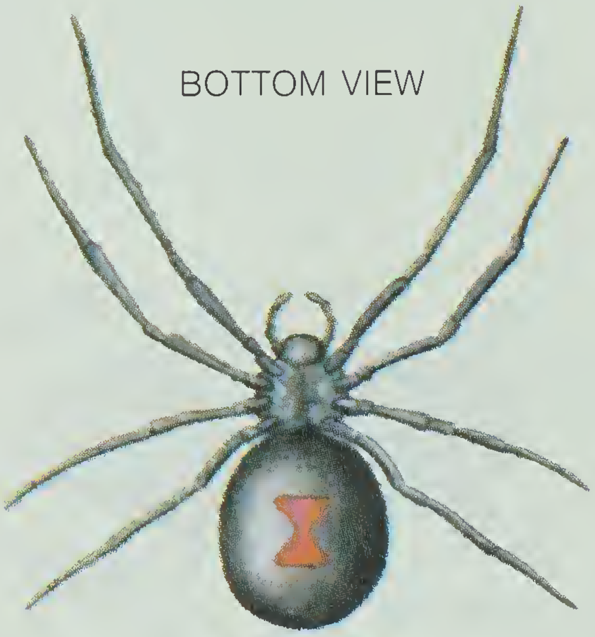
★ **5–11. Describe how you would treat the sting of a wasp if there was only slight pain and swelling around the sting.**

5-11. Apply sunburn lotion and an ice pack.

✓ 5–12. Suppose a child is stung by several bees. What reactions to the stings would tell you to call a doctor?

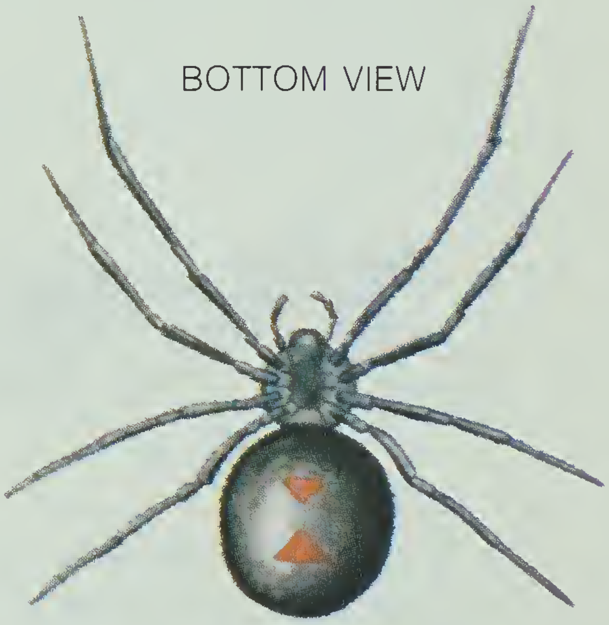
5-12. If the child faints, gets a fever, has difficulty breathing, seeing, or moving a joint near the bite.

Figure 5–4 shows five poisonous bugs. Call a doctor or the local poison control center if you're bitten or stung by one of them.



black widow spider

The black widow is shiny black with a red hourglass underneath the rear part of the body. It is found under trash piles, sand boxes, and around houses and dumps. Black widows live south of the Great Lakes to Florida.



northern widow spider

The northern widow is solid black with a red broken hourglass underneath the rear part of the body. It is found in woods, around stumps, and in stone walls. This species has been found in southern Canada down to north Florida.

Figure 5–4

✓ 5–13. Which spiders dangerous to people are the most widespread?

✓ 5–14. Which of the spiders and scorpions in Figure 5–4 can be found where you live?

★ **5–15. How does the black widow deliver its venom?**

★ **5–16. Name a characteristic that helps identify the black widow spider.**

★ **5–17. Only one of the spiders in Figure 5–4 is usually found in the house. Which one is it?**

5-13. Brown recluse spider.

5-14. Answers will vary with the geographical area.

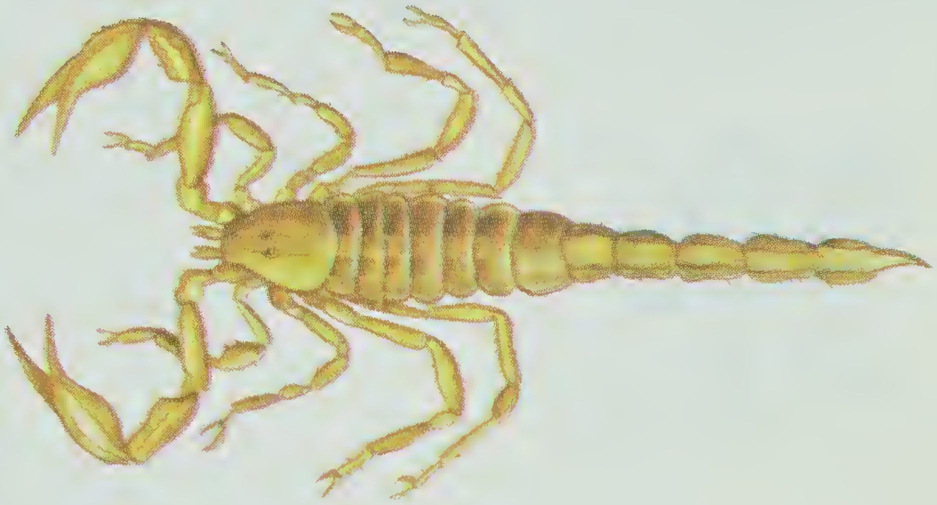
5-15. Through its mouth parts when it bites.

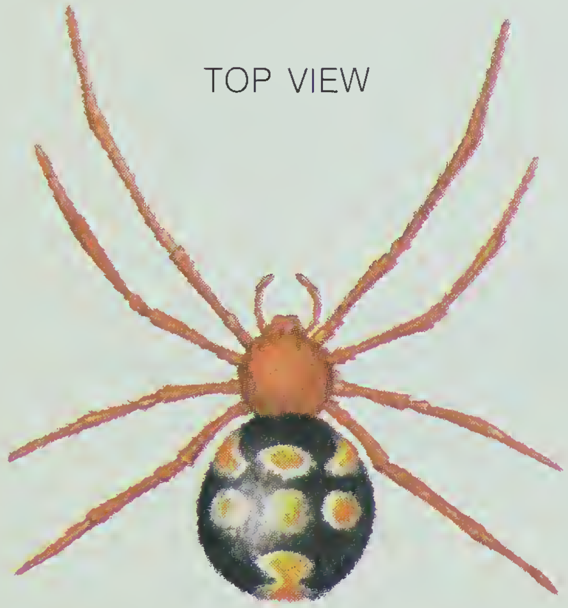
5-16. It's solid black with a red hourglass image on its underside.

5-17. Brown recluse spider.

sculptured centruroides scorpion

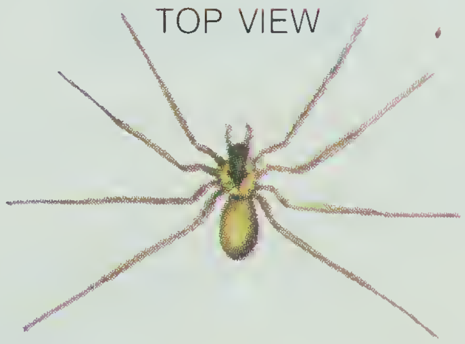
This scorpion is found in the dry, warm climate of Arizona. It is yellowish brown in color. Most stings by scorpions are painful. A sting from this species can be fatal. Call a doctor immediately if you think that you've been stung by this animal!





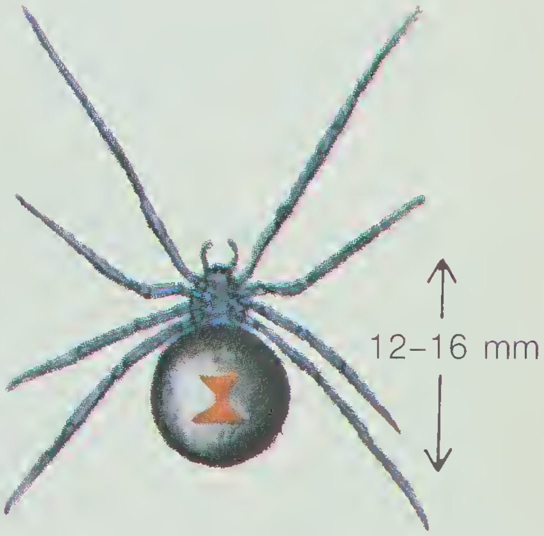
red widow spider

The red widow has a reddish brown body with yellow spots, red legs, and a red head. It is found in scrub pine and palmetto areas of central and south Florida only.

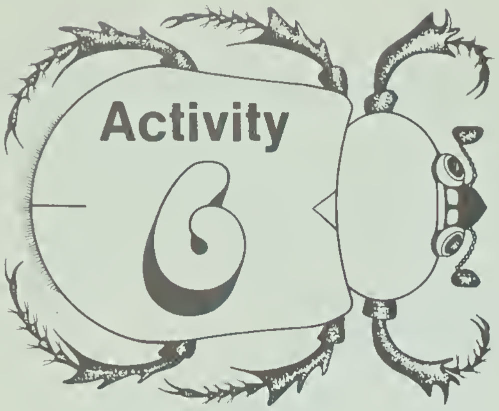


brown recluse spider

The brown recluse has a brown body and legs, with yellowish brown coloring around the head. It is about 11 mm in size, just a bit smaller than the widow spiders. It is found in south central and southeastern parts of the United States. It is usually found in houses, on the floor and behind furniture. Sometimes the species can be seen in garages and basements.



SIZE OF THE FEMALE WIDOW SPIDERS



Bug Control

ACTIVITY EMPHASIS: The use of chemicals in the control of insect pests.

Not all bugs are pests. But when bugs attack crops, spread disease, or destroy houses, they must be controlled. Methods of controlling pests fall into three groups: physical, chemical, and biological.

PHYSICAL

Fly swatters, screens, windows, stomping with feet

CHEMICAL

Sprays, dusts, powders

BIOLOGICAL

Using plants and other animals to control pests, sterilizing insect pests

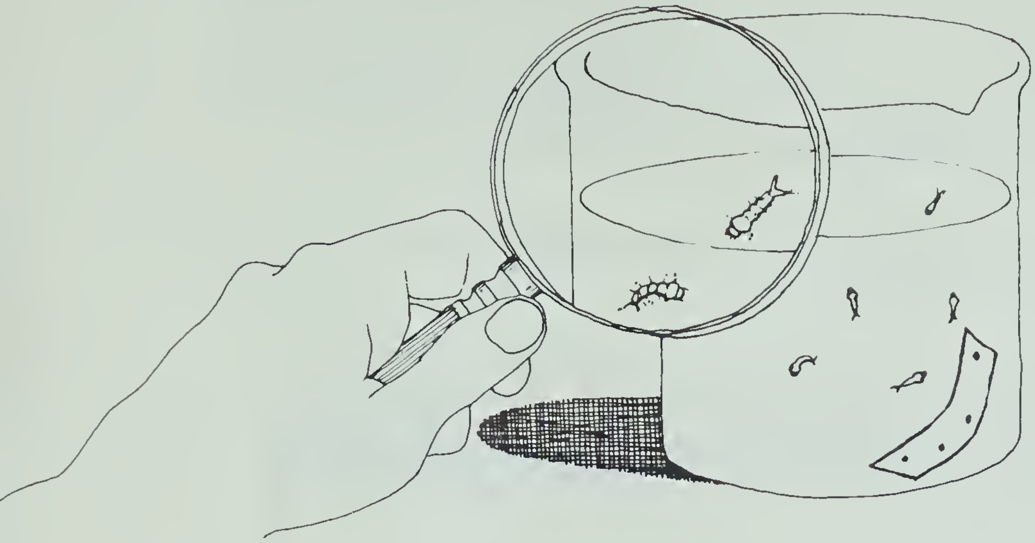
MATERIALS PER STUDENT UNIT

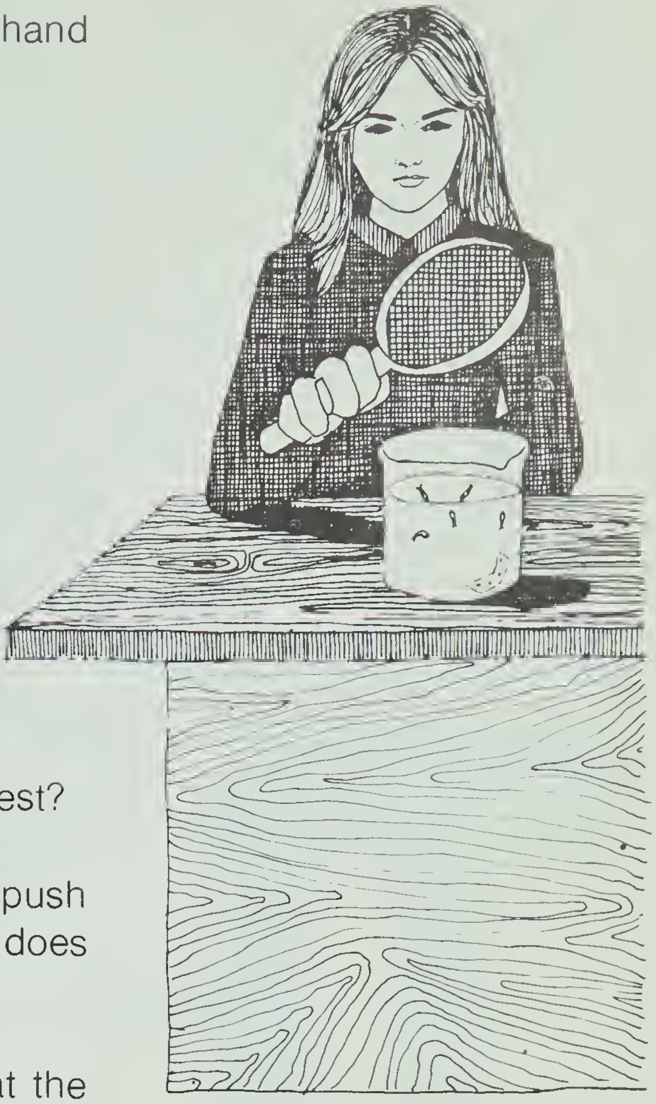
beaker, 100 ml, or small jars
copper sulfate, small piece
dropper, medicine
fish (optional)
fish net (optional)
kerosene, 3 drops
labels, marking
lens, hand, or dissecting microscope
pencil, marking wax
water, distilled, 100 ml

This activity deals with the chemical control of bugs. You'll use your wrigglers from Activity 2. These are the items you will need:

"hatching" beaker containing 12 wrigglers
hand lens
3 small beakers, 50–100 ml, or jars
labels
wax marking pencil
distilled water or collected rainwater
medicine dropper
copper sulfate
kerosene
fish and fish net (optional)

A. Look at the wrigglers in the "hatching" beaker with a hand lens.





✓ 6–1. Where do the wrigglers go when they seem to rest?
6-1. They go to the water's surface.

✓ 6–2. Larvae breathe through those tubes that they push above the surface of the water. How many breathing tubes does each larva have? 6-2. One.

Figure 6–1 shows a wriggler in a "rest" position. Note that the breathing tube is at the surface of the water. The mouth parts are under the water. In this position the larva sucks air through the tube and feeds underwater.

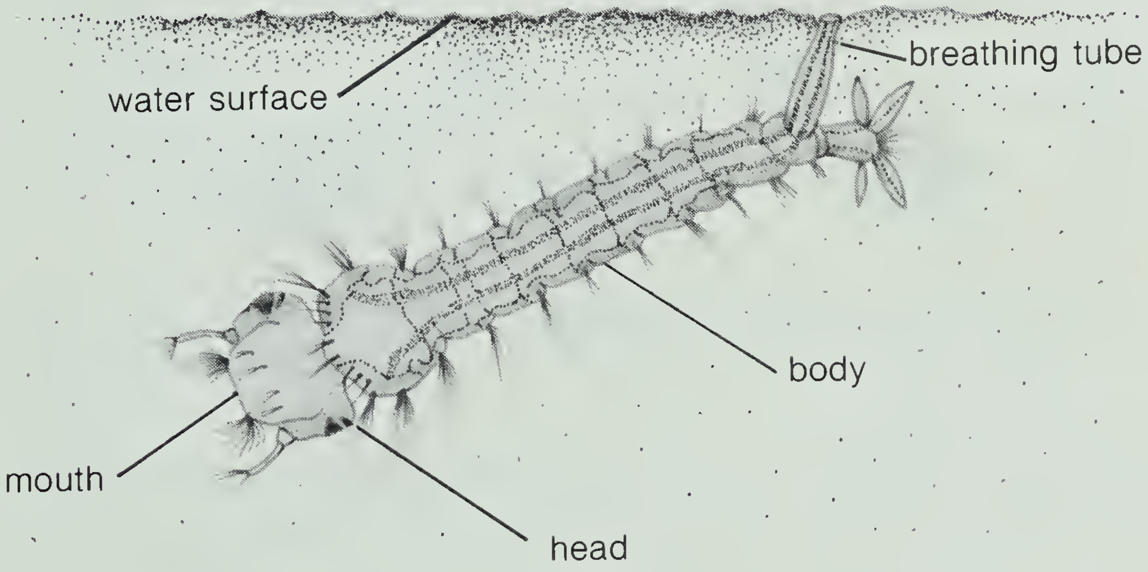
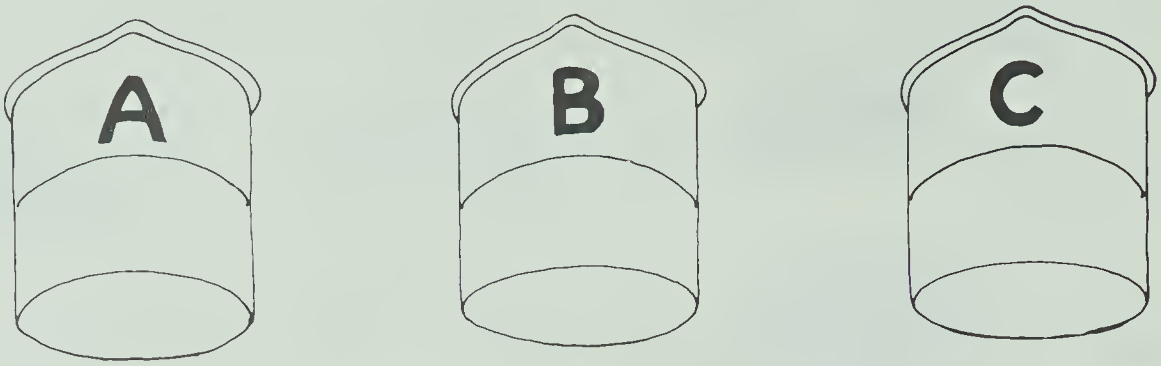


Figure 6–1

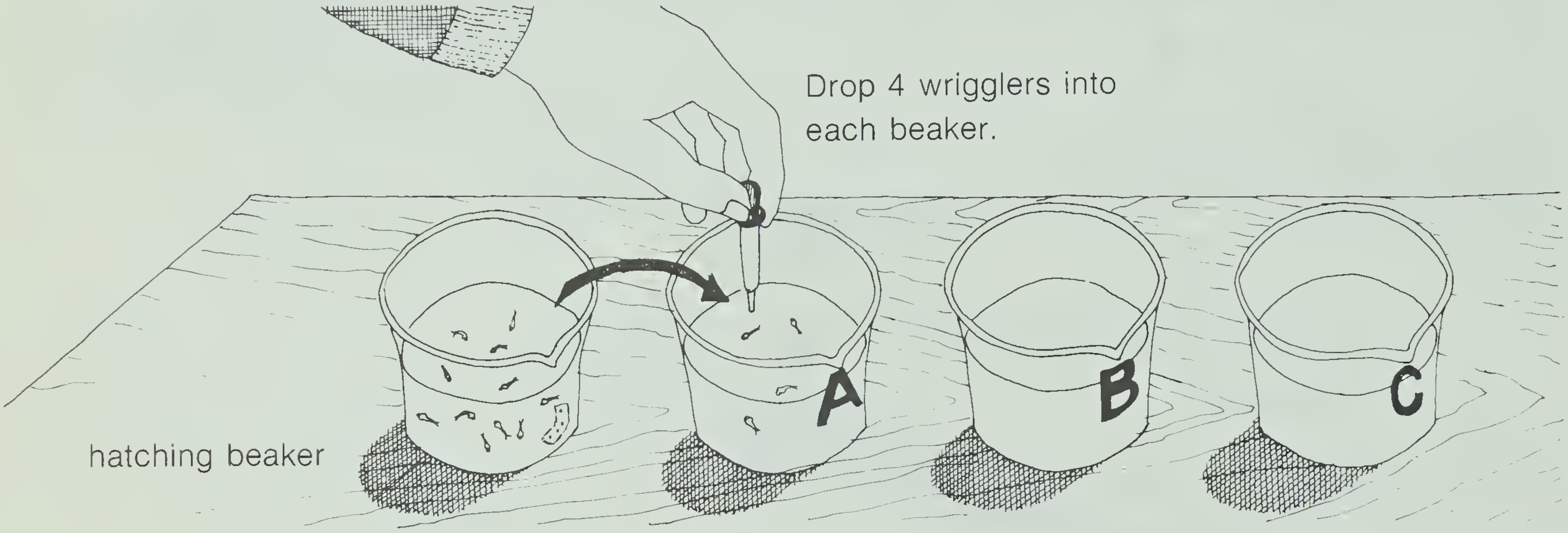
✓ 6–3. The larva is the growing stage in the life cycle of the mosquito. Compare the size of a 5-day-old larva with the one you saw hatch from the egg. How many times larger is the 5-day-old larva? 6-3. Three to five times larger.

Suppose you have been put in charge of a fishing pond. The pond has millions of mosquito larvae in it. The larvae will hatch soon and become pests to a nearby village. Your job is to rid the pond of mosquito larvae without harming the other living things. What chemical would you choose to get rid of the larvae? Examine two possible substances.

B. Label three beakers A, B, and C. Fill each beaker half-full with distilled water or rainwater.



C. Transfer about 4 wrigglers with a medicine dropper from the "hatching" beaker to each labeled beaker.

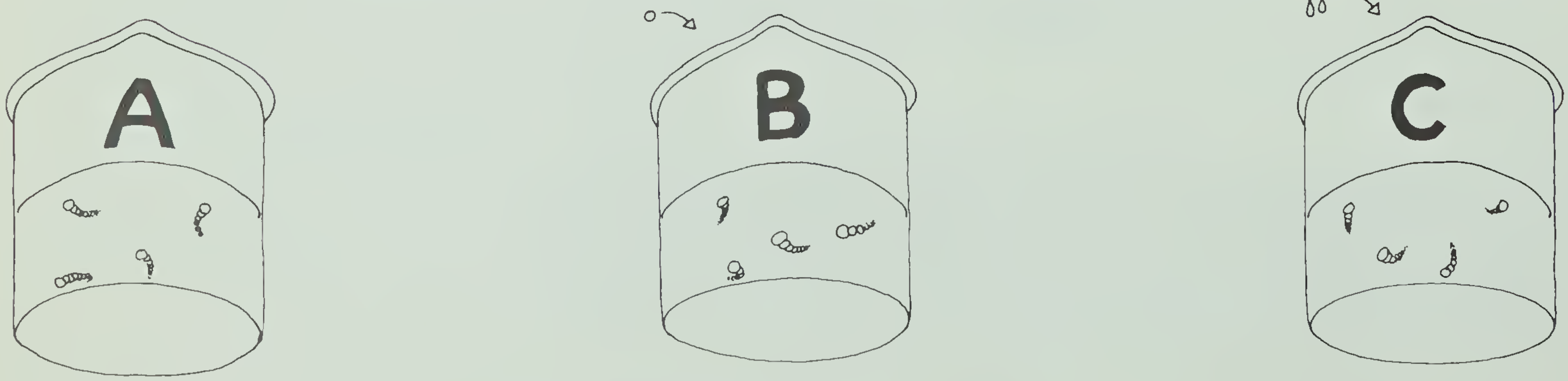

Drop 4 wrigglers into each beaker.

hatching beaker

D. Add one small grain of copper sulfate to Beaker B. Add 3 drops of kerosene to Beaker C. Leave beaker A untreated as a control.

Add 1 grain of copper sulfate to Beaker B.

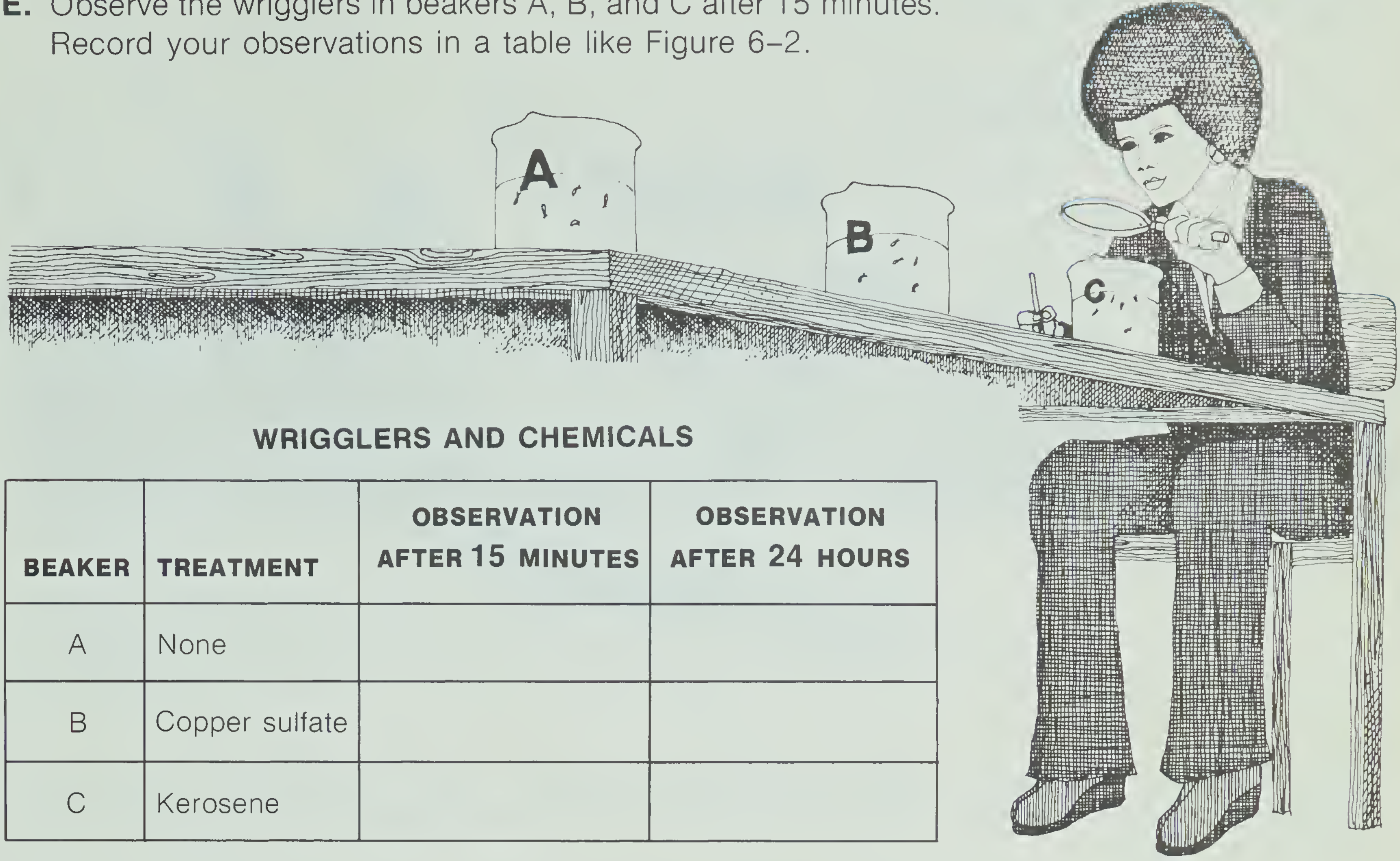
Add 3 drops of kerosene to Beaker C.



✓ 6–4. What's the purpose of a "control" in an experiment? If you can't answer this question, look at *Resource Unit 15* on experiments.

6-4. To be sure of the effect of copper sulfate or kerosene on the larvae, the control tells you what would have happened if you had done nothing to the larvae.

E. Observe the wrigglers in beakers A, B, and C after 15 minutes. Record your observations in a table like Figure 6–2.



WRIGGLERS AND CHEMICALS

BEAKER	TREATMENT	OBSERVATION AFTER 15 MINUTES	OBSERVATION AFTER 24 HOURS
A	None		
B	Copper sulfate		
C	Kerosene		

Figure 6–2

F. Now set the beakers aside for 24 hours. Then record what you see in each beaker.

Twenty Four Hours Later

✓ 6–5. Did the chemicals affect the wrigglers in Beakers B and C? How? 6-5. Yes. They killed the larvae.

✓ 6–6. Examine the surface of the water in Beaker C with a hand lens. What do you observe?

6-6. There seems to be an oily thin film floating on top of the water.

✓ 6–7. Why do you think the wrigglers in Beaker C died? (Here's a clue: The kerosene in Beaker C stayed on the surface in a thin film.)

6-7. The wrigglers inhaled kerosene through their breathing tubes and drowned in it.

Kerosene and other oils kill larvae because the thin film they form over the water clogs the larvae's breathing tubes. Oils are used to control mosquito breeding in ponds and tanks. The oils are eaten up by small animals, so there is no permanent harm to the pond life.

6-8. A blue color has spread through most of the water which was originally colorless.

✓ 6–8. Examine Beaker B. What evidence can you find that the copper sulfate dissolved and spread throughout the liquid?

Copper sulfate is an insecticide. This means that it is poisonous to most insects. It also poisons some water plants, small fish, and other water life.

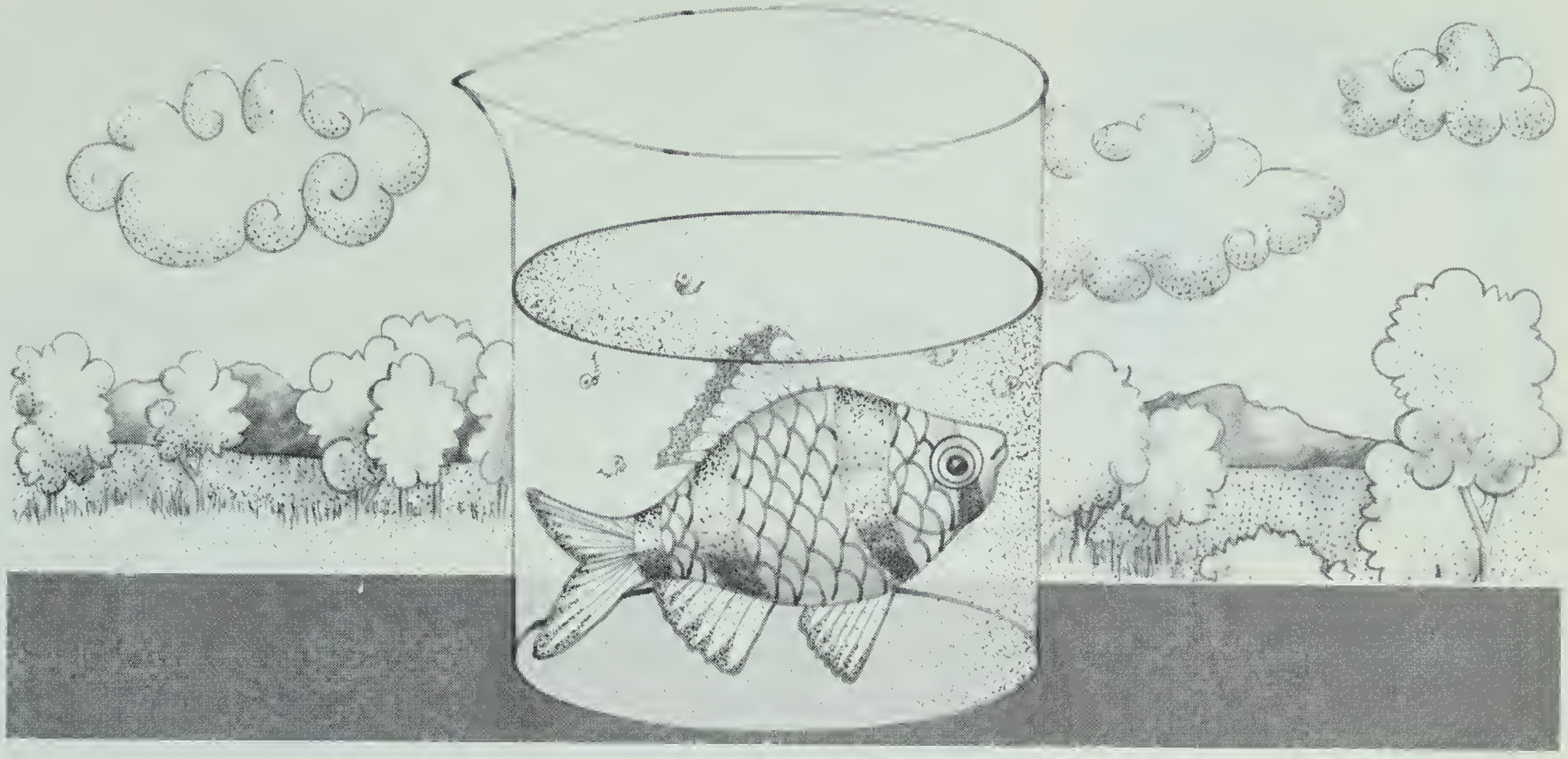
6-9. It isn't confined to just the surface but spreads throughout the water. Wherever it spreads it poisons plants and animals which you might want kept alive.

✓ 6–9. What are the disadvantages of using a poison like copper sulfate to kill mosquito larvae in a pond?

★ 6–10. Which of these two substances — kerosene or copper sulfate — would you use in getting rid of the mosquito larvae in the fishing pond? Why?

6-10. Kerosene would be the better choice because it wouldn't kill the fish and other life in the pond.

Insect control by chemicals has many problems. The most important thing is to choose a chemical that kills insects but does not harm other living things, particularly people. Some commonly used insecticides, like *pyrethrum*, are considered safe. But most insecticides must be used with great caution. DDT was once widely used to control insects that eat crops and carry disease. DDT is now banned in this country because of its serious long-term effects. Some of these effects are discussed in Activity 9.



G. If small fish are available from a school aquarium, use a fish net to transfer a fish to Beaker A, the control. Observe what happens. Record your observations. Return the fish to the aquarium within an hour.

✓ 6–11. What does Step G suggest about another method of controlling mosquitoes? 6-11. The pond or other breeding location could be stocked with fish. The fish would feed on the larvae, thus preventing the production of many adult mosquitoes.

House and Garden Bug Control

ACTIVITY EMPHASIS: The use and effect of common insecticides and safety precautions to be taken.

Insects play an important role in nature. They pollinate plants. They break up and enrich the soil. They provide food for birds, fish, frogs, and other animals. Even certain plants, like the pitcher plant, trap insects for food. In some parts of the world people eat insects as we eat shellfish. Some insects feed on harmful bugs, thereby getting rid of pests naturally. Certain insects provide important products such as honey, shellac, and silk. In fact, only about one percent of all insects are pests.

Many pests live around homes and gardens. They feed on plants and animals. Some of them are shown in Figure 7–1.

MATERIALS PER STUDENT UNIT
cigarette, nonfilter
dropper, medicine
lens, hand, or dissecting microscope
stirring rod
test tube, small
test tube, large

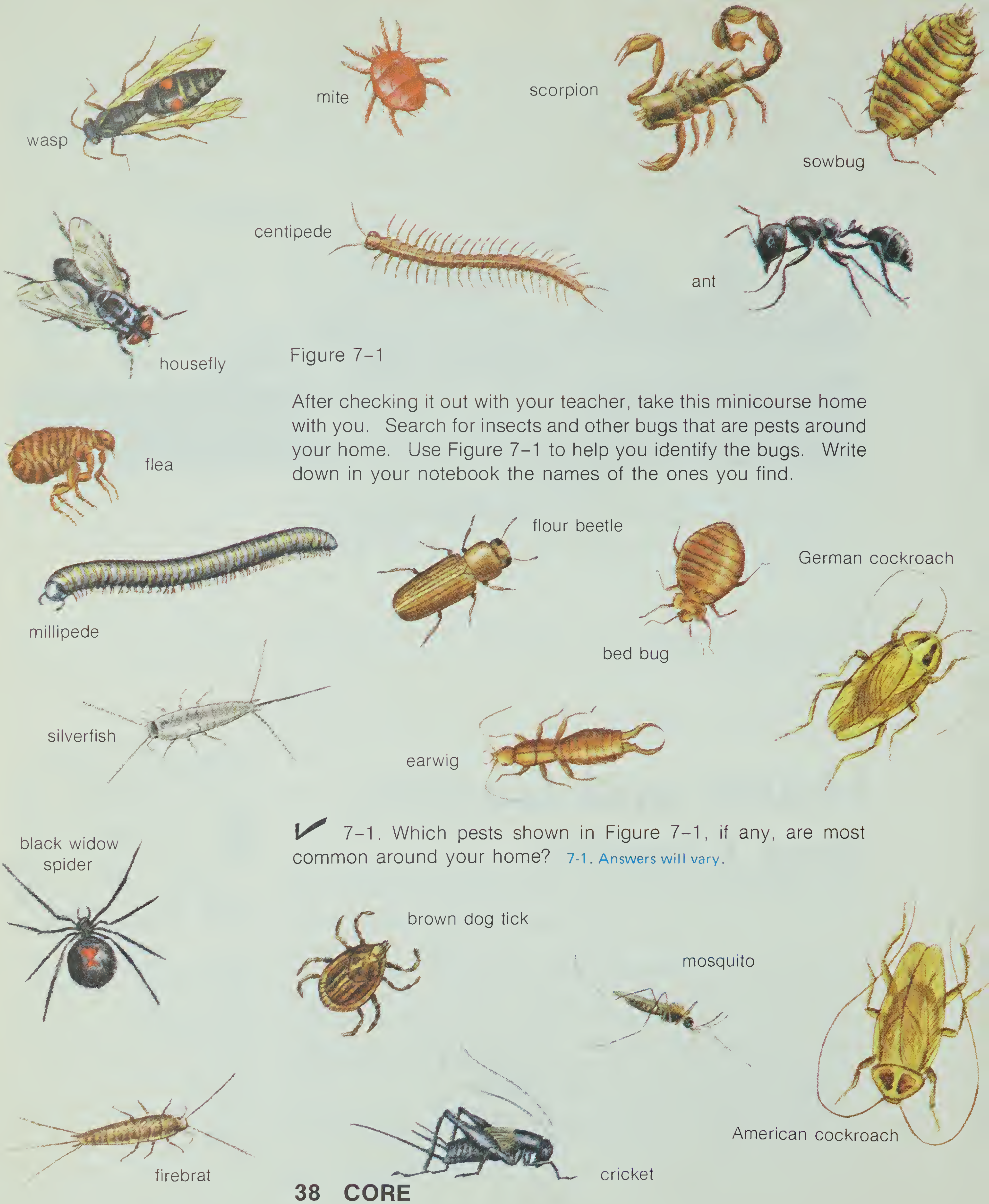


Figure 7–1

After checking it out with your teacher, take this minicourse home with you. Search for insects and other bugs that are pests around your home. Use Figure 7–1 to help you identify the bugs. Write down in your notebook the names of the ones you find.

✓ 7–1. Which pests shown in Figure 7–1, if any, are most common around your home? 7-1. Answers will vary.

A *pesticide* is any chemical used to control pests. The pests can be insects and other bugs, fungi, weeds, or other harmful plants or animals. *Insecticides* are a type of pesticide. Insecticides are chemicals that control insects. Some pesticides also kill mites, ticks, and other bugs that are not insects.

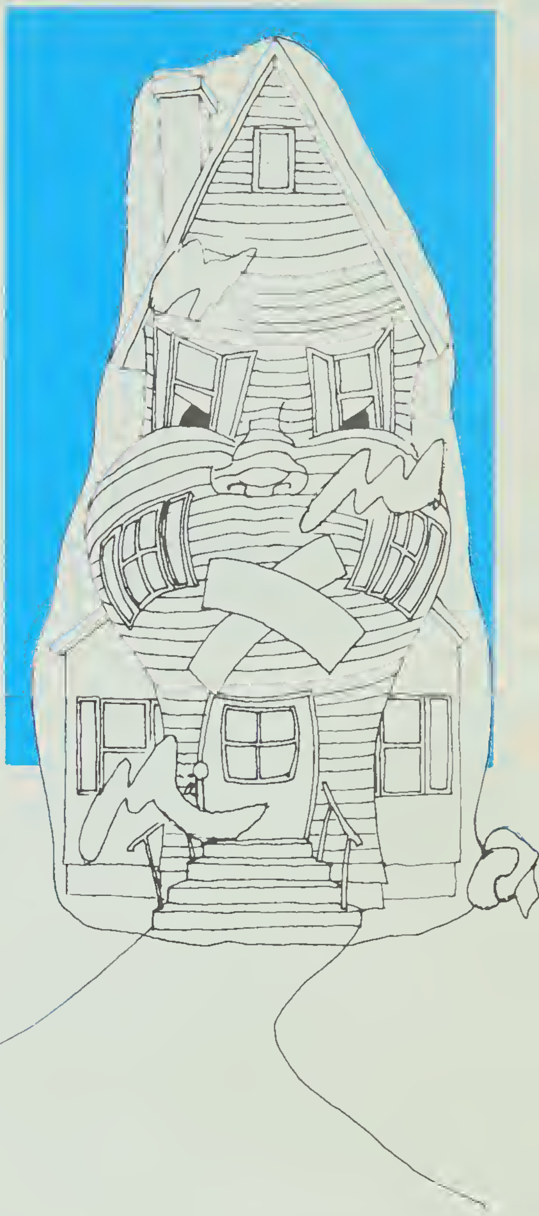
How do insecticides kill bugs? Some need only touch the pest to kill it. Some must be swallowed by the pest. Insecticides fall into three groups according to their effect: stomach poisons, contact poisons, and fumigants. Figure 7–2 shows the three groups.

STOMACH POISONS

How To Use: Apply directly to any food that the pest is likely to eat, such as leaves, bark, and food crops.

How It Works: When the pest eats the poisoned food, the poison enters the body and kills it.

Bugs It Works Against: Bugs with chewing mouth parts, such as the cockroach, ant, grasshopper, and cricket.



CONTACT POISONS

How to Use: Apply to any surface that the pest is likely to walk on.

How It Works: The chemical penetrates the body of the pest and kills it. Also works as a stomach poison if eaten.

Bugs It Works Against: All types of bugs. Used to control flies, fleas, mosquitoes, and bed bugs.

Figure 7–2

FUMIGANTS

Fumigants are poison gases. They enter the bugs's breathing system and cause death.

For a fumigant to work, the area must be sealed off so the gas can't escape before all the bugs have been affected.

Fumigation is often used to kill all of the bugs in an entire building. All the doors and windows would be sealed off. Sometimes a big "tent" or bag is put over the building. Then a poison gas is pumped in.

When a building is being fumigated, all people and pets must leave.

When you use moth balls to get rid of clothes moths, you're fumigating and repelling bugs at the same time!

Before you can select the right insecticide, you must first identify the bug. You may need help in identifying the pest and in deciding which chemical to use. Contact your state or local agency that deals with pest control. Some insecticides are so highly poisonous that they can only be used by people who are specially certified to use them. These insecticides are labeled "restricted." However, there are "general" insecticides which are sold commercially.

7-2. Answers will vary.

✓ 7–2. Examine the label on a commercial insecticide. It may be a spray can or a liquid. What are the active ingredients — the insect killers — of the insecticide?

7-3. Insecticides enter the body (1) orally, (2) through the skin, and (3) by inhalation.

★ 7–3. How does each insecticide in Figure 7–2 kill the insect?

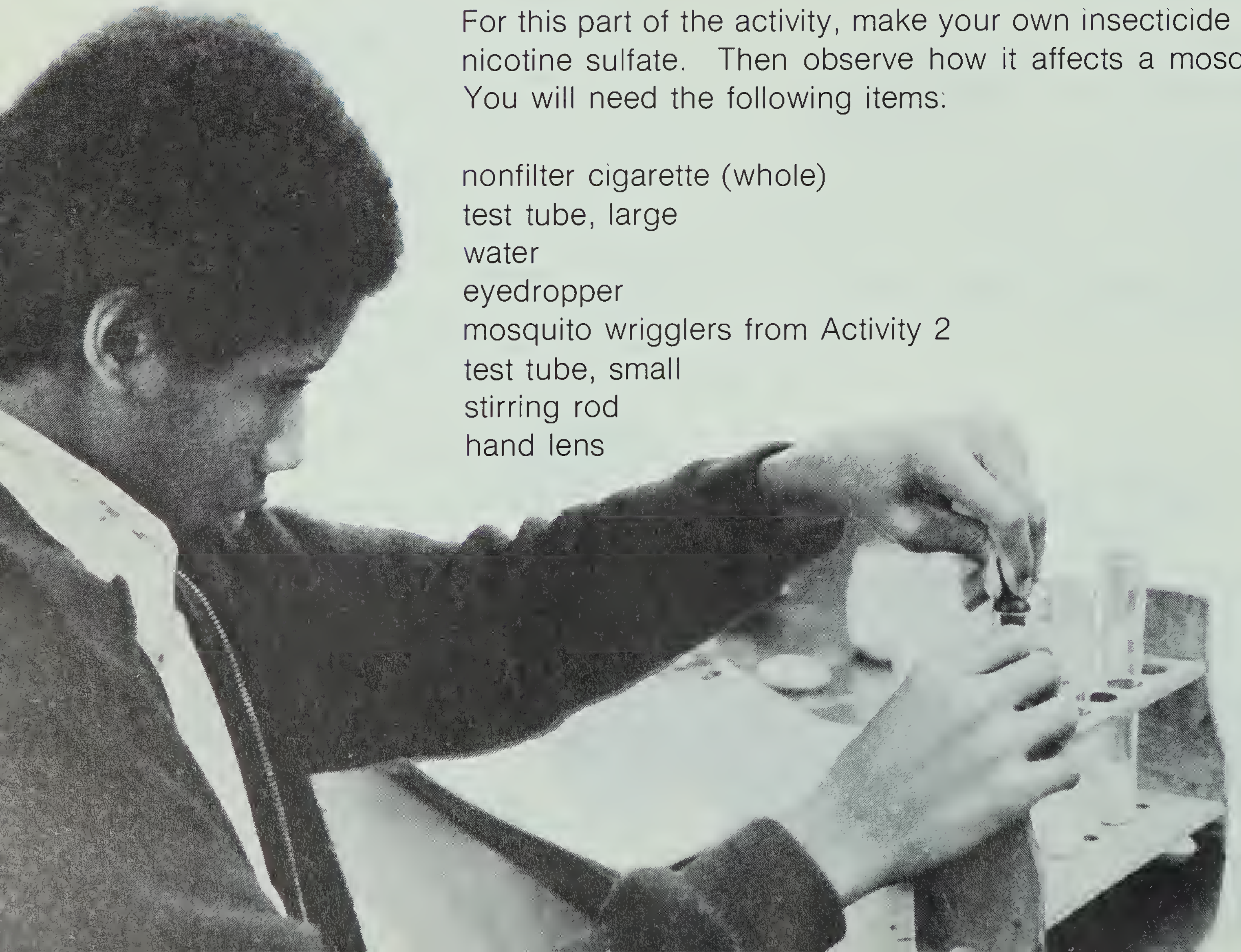
7-4. "Control" means that all insects aren't killed. They're simply repelled or their numbers reduced.

✓ 7–4. Some insecticide labels say that the chemical "kills" certain insect pests. Other labels say that the chemical "controls" certain insect pests. What do you think is the difference between "kill" and "control"?

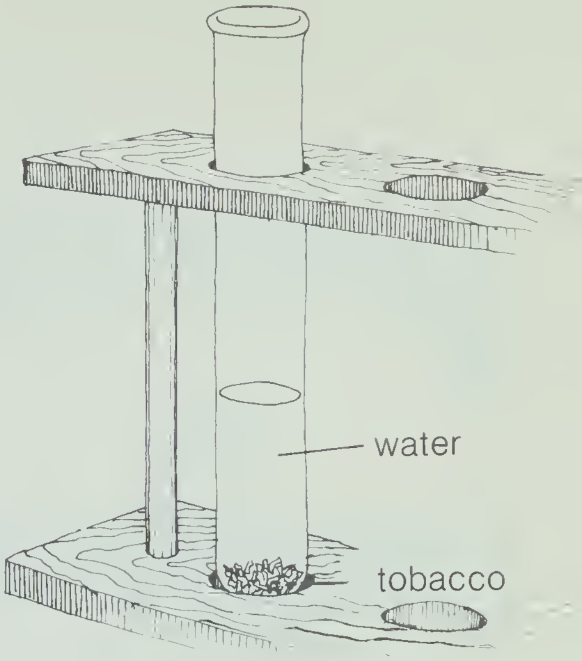
MAKING YOUR OWN INSECTICIDE

For this part of the activity, make your own insecticide solution — nicotine sulfate. Then observe how it affects a mosquito larva. You will need the following items:

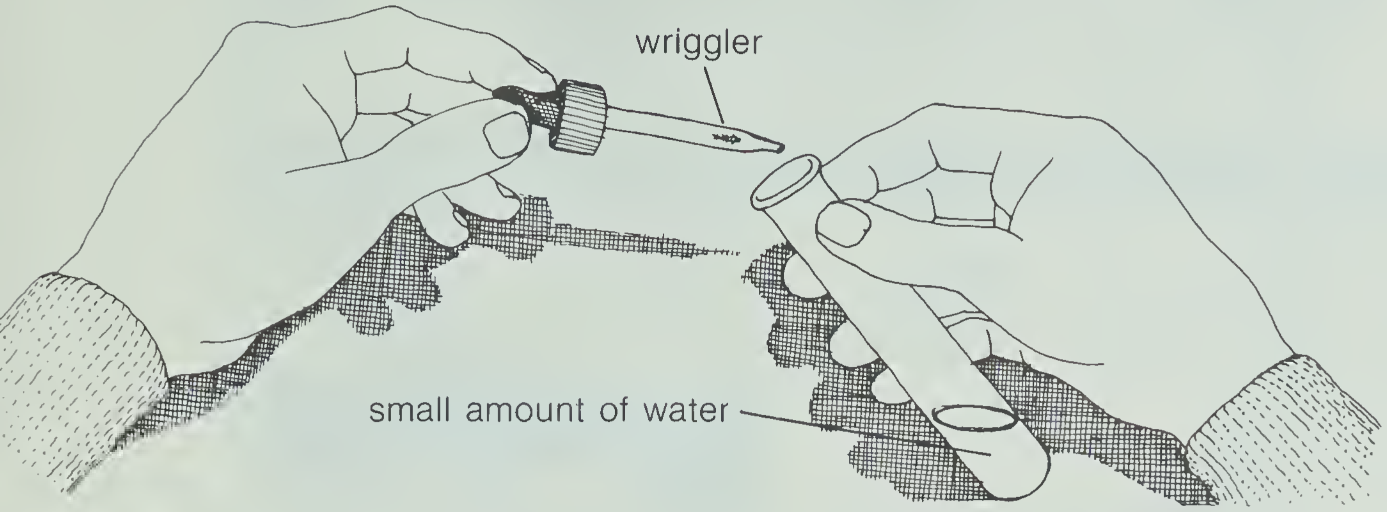
nonfilter cigarette (whole)
test tube, large
water
eyedropper
mosquito wrigglers from Activity 2
test tube, small
stirring rod
hand lens



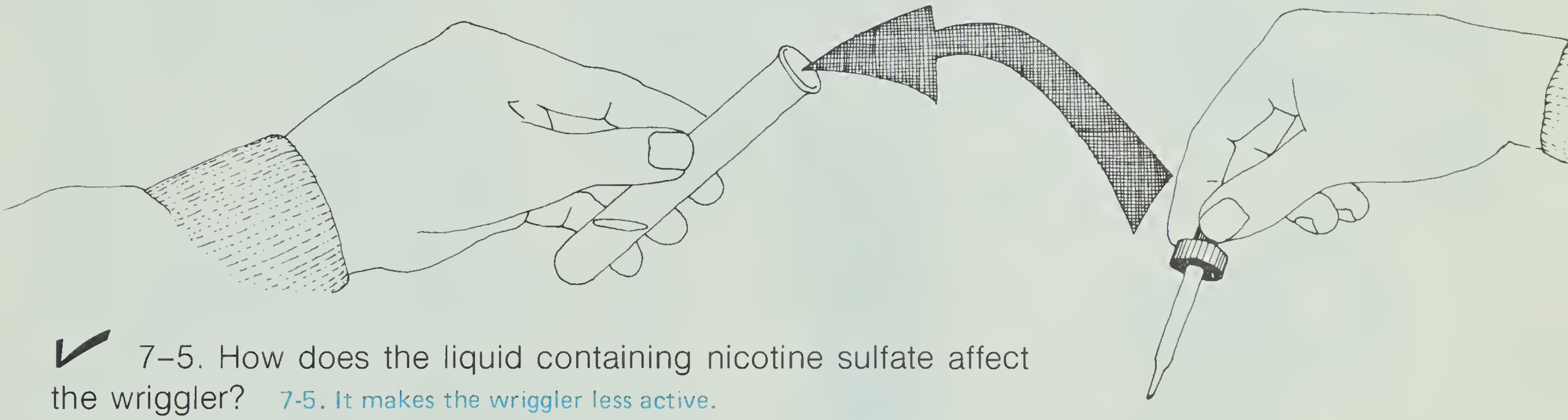
A. Break open the cigarette and put all of the shredded tobacco into the large test tube. Fill the test tube ⅓ full of water. Allow the test tube to stand overnight. Nicotine sulfate will leak out of the tobacco and into the water.



B. Use a medicine dropper to transfer one wriggler and a small amount of water to the small test tube.



C. Now transfer 4 to 5 drops of liquid from the test tube containing the tobacco into the test tube with the wriggler. Don't draw any tobacco strands in with the liquid. You can use a stirring rod to push the strands out of the way.

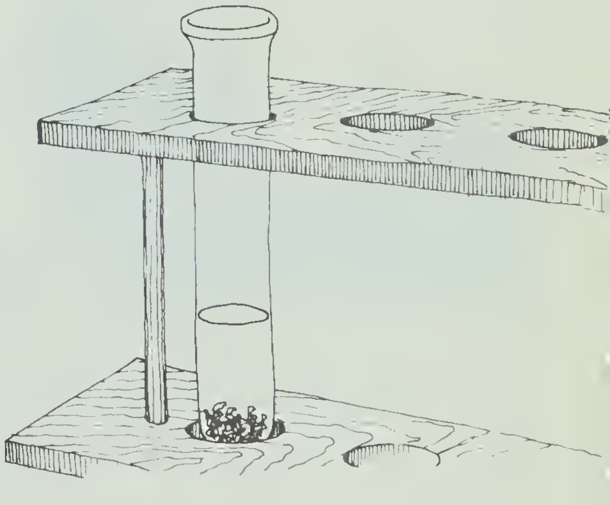


✓ 7–5. How does the liquid containing nicotine sulfate affect the wriggler? 7-5. It makes the wriggler less active.

✓ 7–6. Wait 10 minutes. Examine the wriggler with a hand lens. What has happened? 7-6. There may be some slight movement.

✓ 7–7. Wait another 10 minutes. Examine the wriggler again. Describe what you see. 7-7. No movement.

Your observations should convince you that cigarettes contain a substance that can kill insects. Tobacco contains nicotine sulfate, an insect poison. In fact, much of the nicotine sulfate made for insect poison in the United States comes from tobacco wastes.

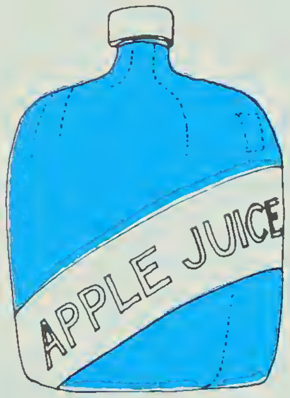


USING INSECTICIDES SAFELY

Most chemicals that kill insects can also kill people. Fortunately, the amount needed to kill insects is usually far less than the amount needed to kill humans. But care must be taken. If you're careless and don't follow directions, you can get a dose of insecticide big enough to make you sick, or maybe even kill you. Figure 7-3 gives rules for using insecticides safely.

INSECTICIDE: HOW TO USE: READ THE DIRECTIONS. FOLLOW THEM.

Nearly all insecticides can kill you or make you sick if you're careless or sloppy when using them. Keep these ideas in mind and chances are you'll be O.K.



Never store insecticides in empty food containers.

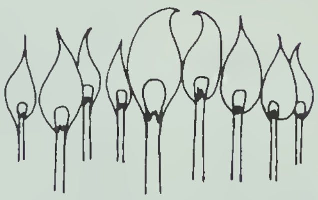
Keep insecticides out of reach of small children.

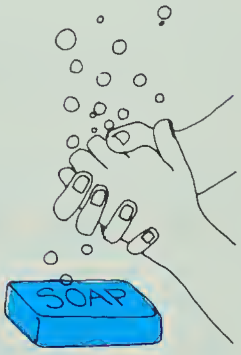
Never spray insecticides near food.

Wear gloves and a mask when using a garden spray.

Never smoke, drink, or eat when using an insecticide.

Never spray near an open flame.





Wash thoroughly after using insecticides.

Figure 7-3

Study the pictures in Figure 7–4. The people in the pictures are endangering their lives and those of others. Answer Question 7–8.

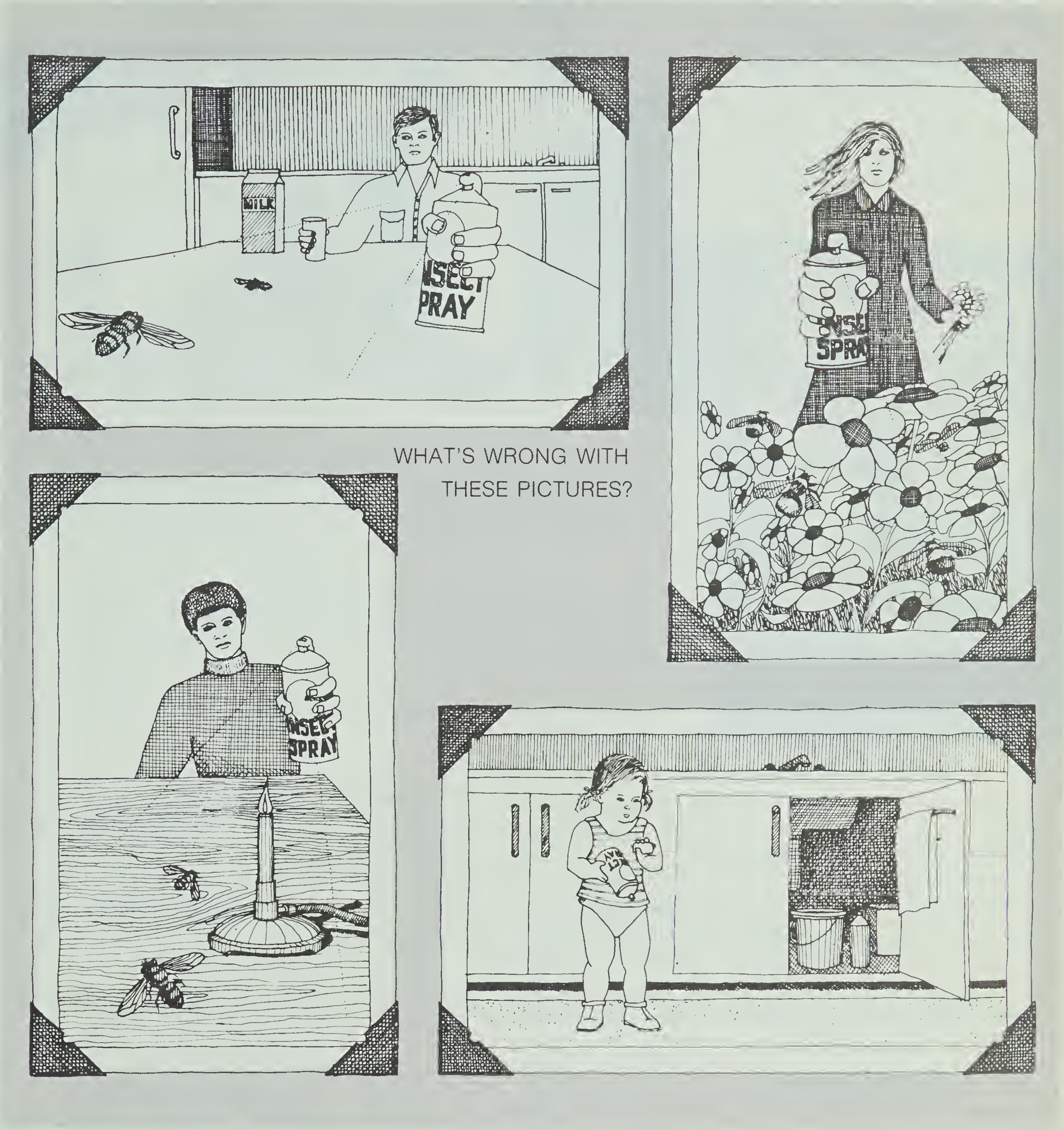
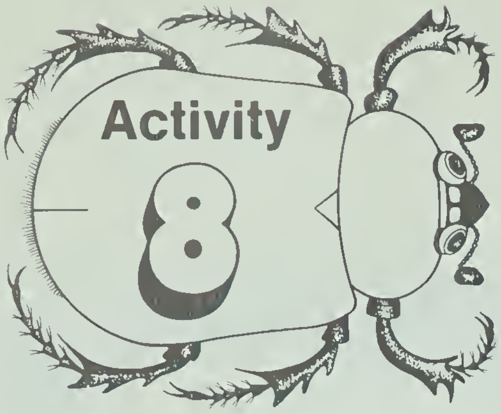


Figure 7–4

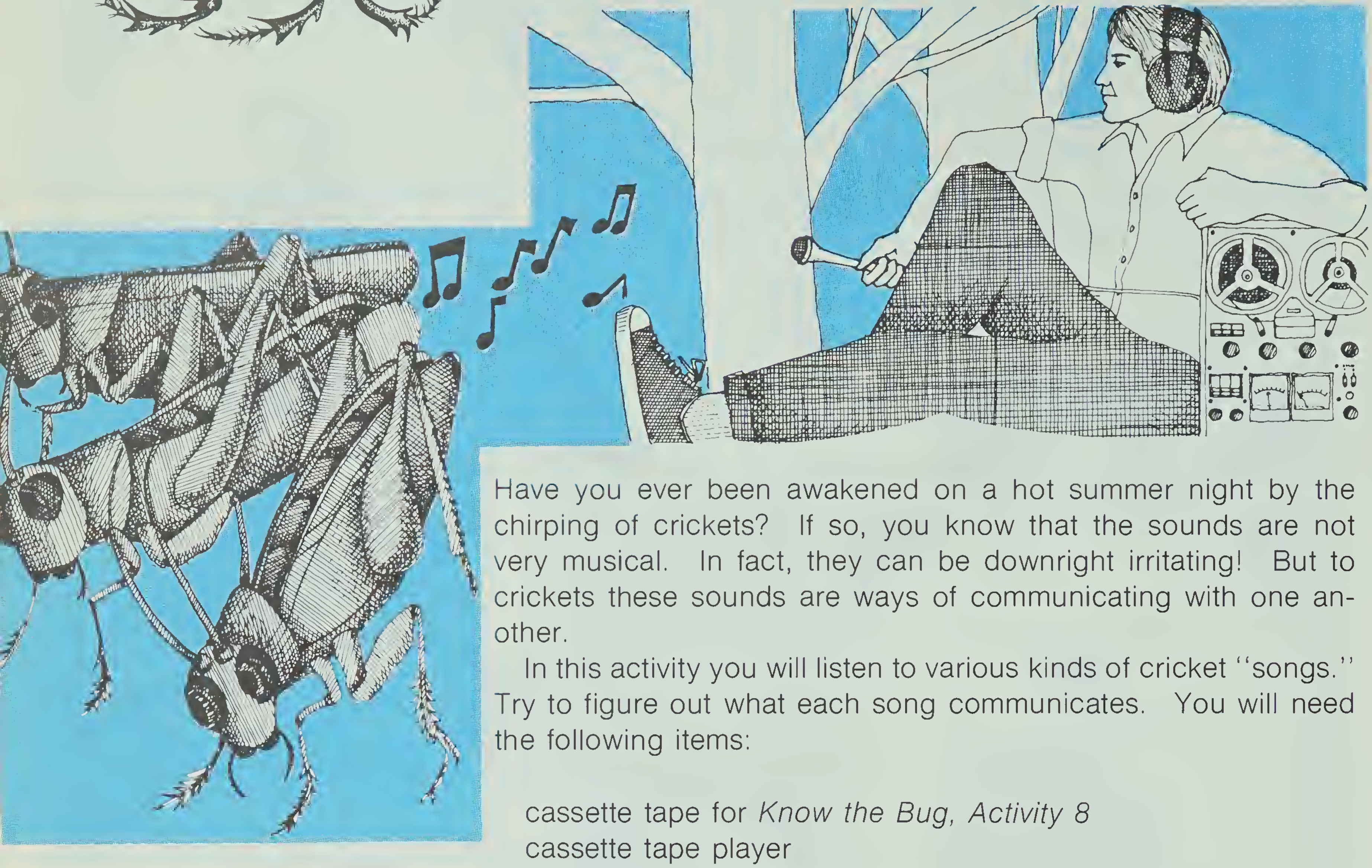
7-8. 1. He could accidentally spray insecticide on his food, which would then enter his stomach.
2. She could be breathing in poisons. Also, if she were to touch food later with her hands she could get poisons on the food.
3. The flame could ignite the contents of the spray can.
4. The child is likely to get some poisons into her stomach from her hands.

✓ 7–8. What is wrong in each picture of Figure 7–4?



Decoding Cricket Songs

ACTIVITY EMPHASIS: How crickets use sound to communicate through changes in rhythm.



Have you ever been awakened on a hot summer night by the chirping of crickets? If so, you know that the sounds are not very musical. In fact, they can be downright irritating! But to crickets these sounds are ways of communicating with one another.

In this activity you will listen to various kinds of cricket "songs." Try to figure out what each song communicates. You will need the following items:

cassette tape for *Know the Bug, Activity 8*
cassette tape player

MATERIALS PER STUDENT UNIT
cassette tape for *Know the Bug*
cassette player, preferably with headphones

Listen to the first part of the cassette tape. The songs of male crickets have been recorded on this side. When you are asked to do so, answer the following questions.

✓ 8–1. Which song sounds like the courting song: Song 1, Song 2, or Song 3? Explain your answer.

✓ 8–2. Which song sounds like a calling song? Why?

✓ 8–3. Which song sounds like a fighting song? Why?

8-1. Answers will vary; Song 3 is correct.

8-2. Answers will vary; Song 1 is correct.

8-3. Answers will vary; Song 2 is correct.

After you have answered the questions, go back to the tape. The tape will tell you whether your answers are correct. The tape will also refer you to Figure 8–1, which shows how crickets make sounds.

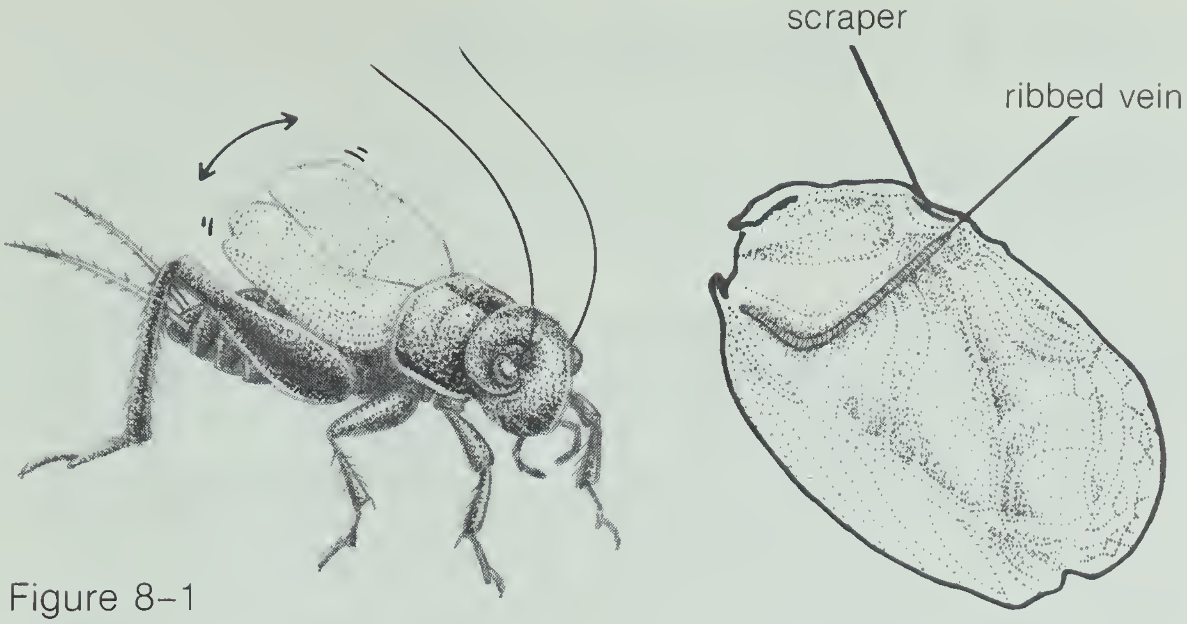


Figure 8–1

The cricket "fiddles" by scraping the two wings together very fast. Under each wing is a ribbed vein. Each wing has a scraper. When the scraper of one wing rubs against the ribbed vein of the other, they produce the cricket's song.

✓ 8–4. Which of the three crickets you heard on the tape has the slowest chirp rate? 8-4. Caribbean field cricket.

1. sand field cricket
2. southeastern wood cricket
3. Caribbean field cricket

✓ 8–5. Which cricket has an irregular chirp rhythm? 8-5. Southeastern wood cricket.

1. sand field cricket
2. southeastern wood cricket
3. Caribbean field cricket

Cricket songs are strongly affected by temperature. In fact, you can estimate temperature by the number of chirps a cricket makes.

Copy Figure 8–2 in your notebook. Then go back to the tape. When you are asked to do so, record your data for Figure 8–2 in your notebook.

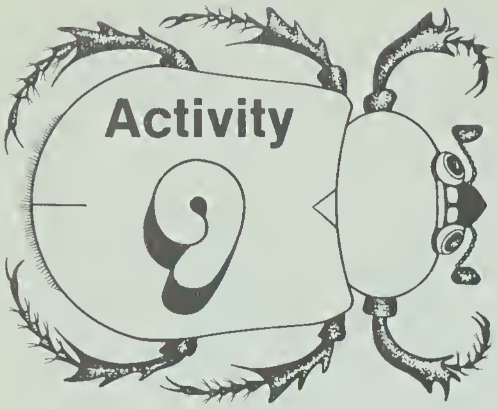
CRICKETS AND TEMPERATURE

SONG	ACTUAL TEMPERATURE	NO. OF CHIRPS IN 14 SECONDS (N)	CALCULATION $\frac{5}{9}(N+8)$	ESTIMATED TEMPERATURE
1	15°C			
2	21°C			
3	27°C			

Figure 8–2

✓ 8–6. How close was your estimated temperature to the actual temperature in Song 1? Song 2? Song 3?

8-6. Answers will vary but the estimated temperature should be within two degrees of the actual temperature.

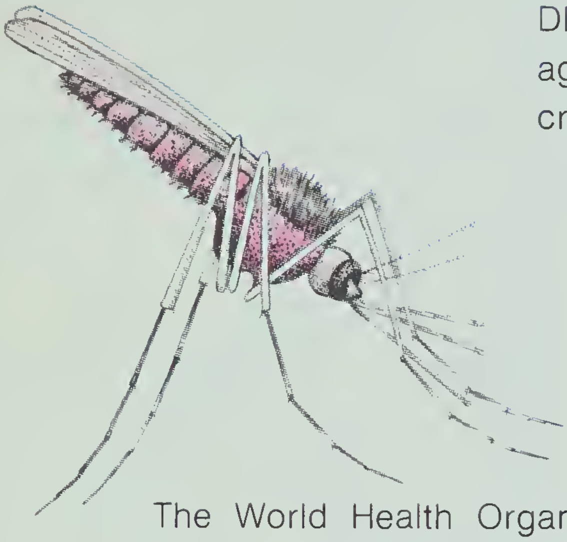


DDT: Boon or Doom?

ACTIVITY EMPHASIS: The history of DDT and some of the unanticipated side effects which occurred with its use.

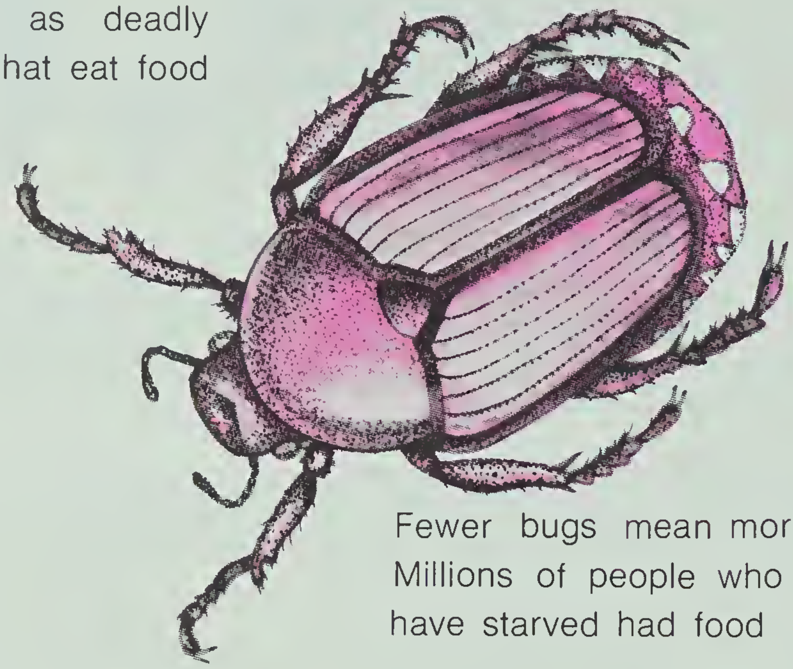
MATERIALS PER STUDENT UNIT
None.

Some things in this world start off very well — and end up badly. Put another way, the best intentions can sometimes produce the worst results! The story of DDT is an example. DDT is a pesticide that was developed in the 1940s. Scientists were looking for an insecticide that really worked. DDT *really* killed insects and other bugs that were spreading diseases and destroying crops. It wasn't long before DDT was being used throughout the world.



The World Health Organization used DDT in a worldwide attack on the mosquitoes that carry malaria. DDT worked.

DDT was just as deadly against insects that eat food crops.



Fewer bugs mean more food. Millions of people who might have starved had food to eat!

Then a strange thing happened. Some insects developed a "resistance" to normal amounts of DDT. The insects got a little wet when sprayed, but otherwise the DDT didn't bother them. That meant that more and more DDT was needed to kill the insects.

Some insects developed a "resistance" to normal amounts of DDT.

So, more and more DDT was needed to kill the insects.

Another alarming thing happened. Tiny amounts of DDT were showing up in the fat of polar bears and in the breast milk of Eskimo mothers. How did the insecticide get so far North — thousands of miles from where it was being sprayed? The question was asked, "If it's there, could it be found in other places?" Sure enough, it was found in many distant places. It was found everywhere.

Scientists found that there were two reasons why DDT was showing up in polar bears and pelicans, igloos and eagles. First, DDT is persistent — it hangs around for a long time and doesn't break down into something else. Second, DDT is stored in the fatty tissues of animals and remains in the body.

★ 9–1. Consider the fact that DDT stays in the body for a long time. The body may be that of a person, a bird, or some other animal. Why is this likely to be a problem?

9-1. A large animal could take in DDT from each of the many smaller animals it eats. Each smaller animal could have DDT in it from the even smaller plants and animals it eats. Thus, the largest animal could take in a lot of DDT from many sources.

Big animals eat smaller animals. In fact, big animals eat a *lot* of smaller animals for survival.

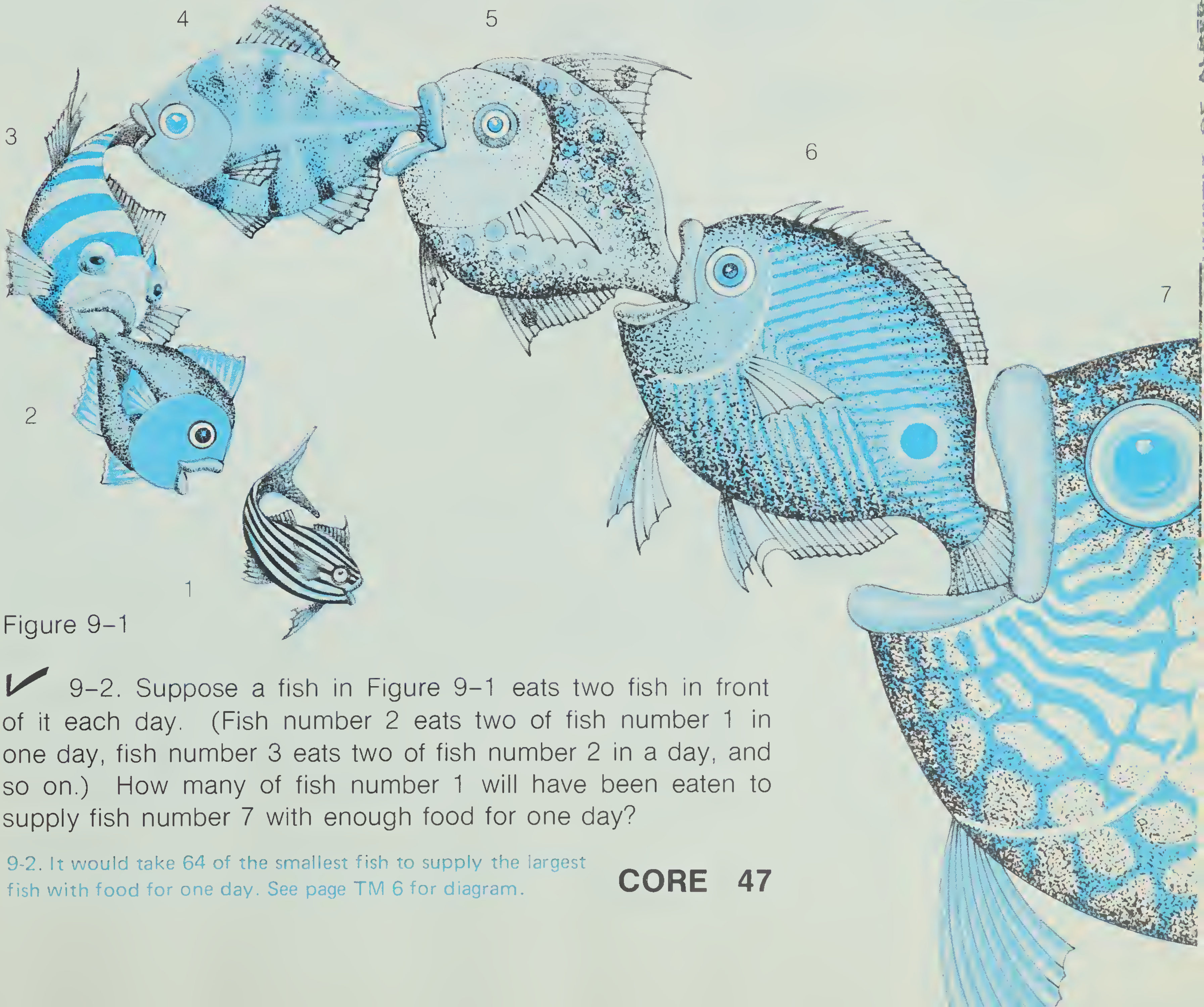
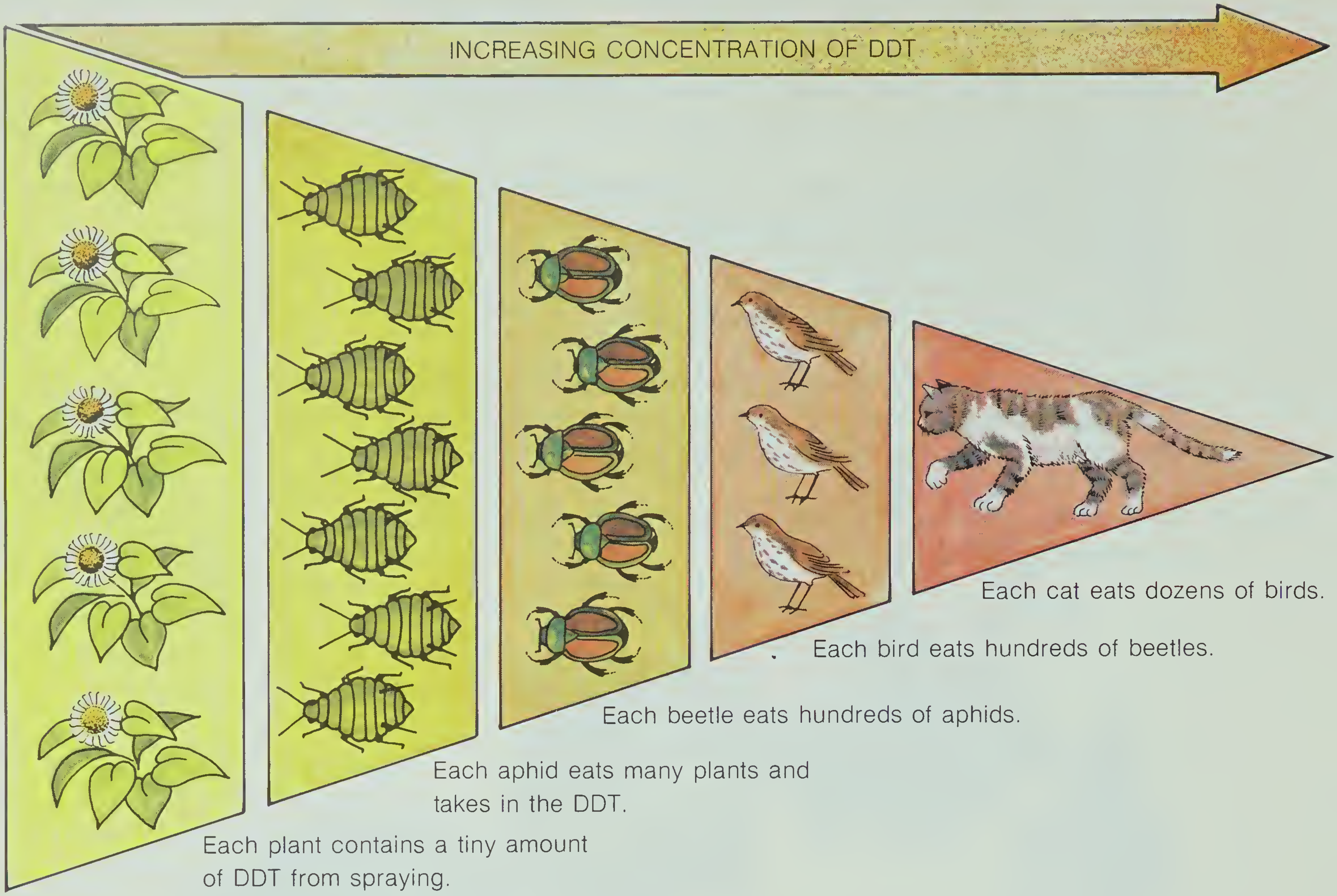


Figure 9–1

✓ 9–2. Suppose a fish in Figure 9–1 eats two fish in front of it each day. (Fish number 2 eats two of fish number 1 in one day, fish number 3 eats two of fish number 2 in a day, and so on.) How many of fish number 1 will have been eaten to supply fish number 7 with enough food for one day?

9-2. It would take 64 of the smallest fish to supply the largest fish with food for one day. See page TM 6 for diagram.

Now look at the food chain shown in Figure 9–2.



Each cat eats dozens of birds.

Each bird eats hundreds of beetles.

Each beetle eats hundreds of aphids.

Each aphid eats many plants and takes in the DDT.

Each plant contains a tiny amount of DDT from spraying.

Figure 9–2

✓ 9–3. Almost all of the DDT that was in thousands of aphids could end up in the cat, even if the cat never ate a single aphid. How could this happen?

9-3. The cat would eat birds which had DDT in them. The birds contain DDT because they ate beetles which had DDT. The beetles contained DDT because they ate the aphids which got DDT by eating plants sprayed with DDT.

People began to be concerned about all of this DDT collecting in their bodies. They knew that DDT kills bugs. Bugs are living things. So are people and other animals. Could too much DDT, they asked, kill other living things besides bugs? Unfortunately, the answer was yes.

In 1957 a study was made at Clear Lake in California. This time scientists used DDD instead of DDT. DDD is also an insecticide, slightly less powerful than DDT, but just as persistent. Scientists wanted to find out how much DDD had collected in each plant or animal that was eaten by a larger animal. Figure 9–3 shows what they found.

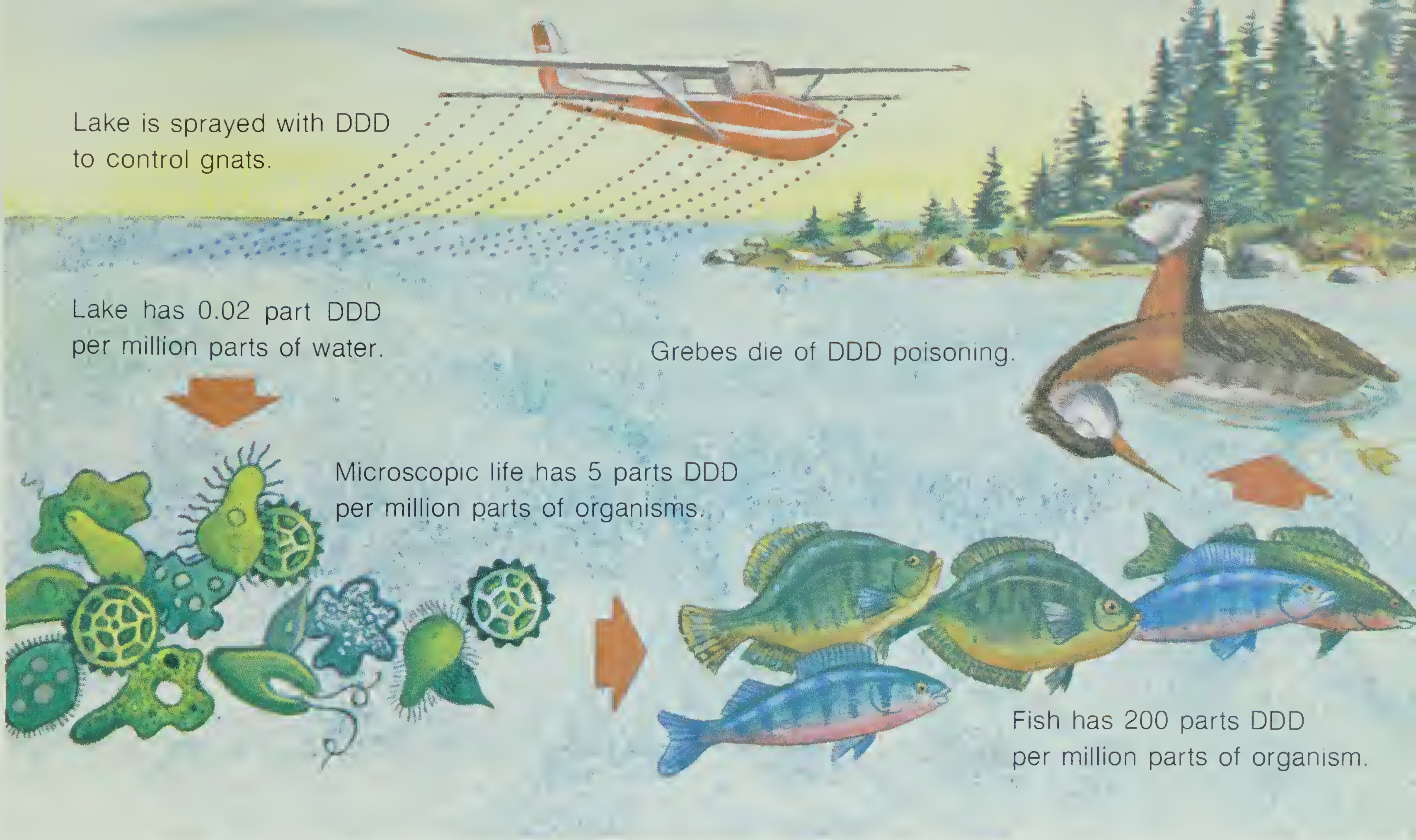
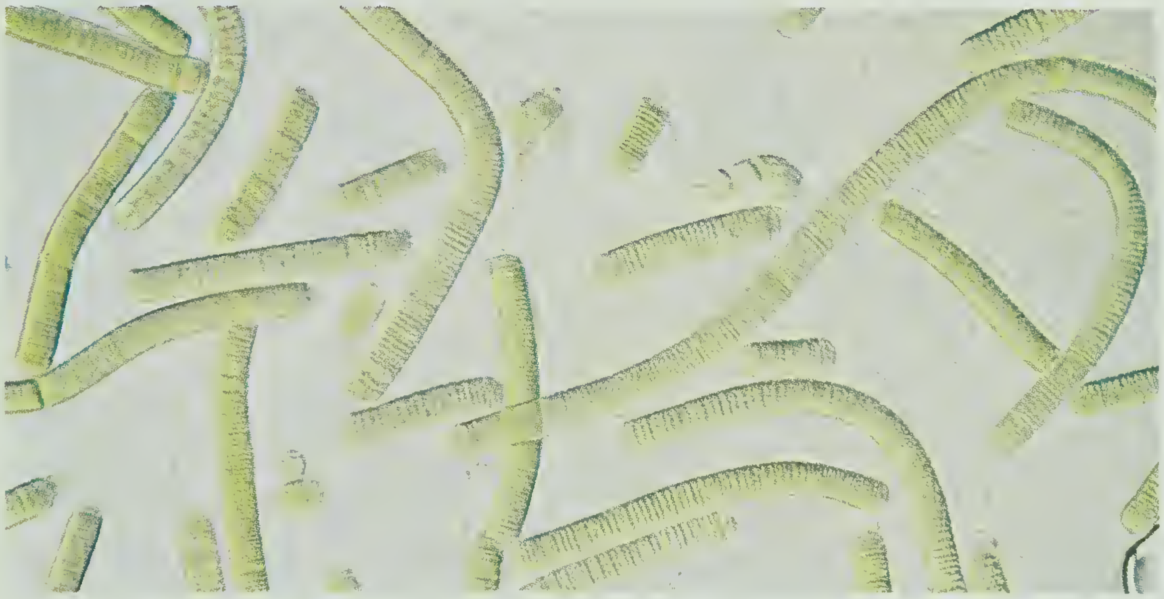
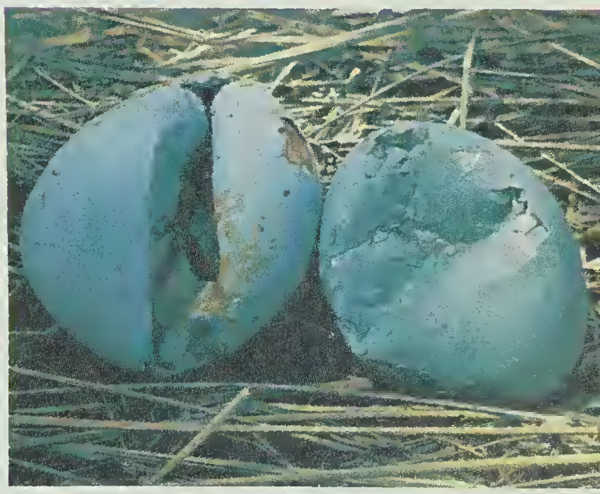

Lake is sprayed with DDD to control gnats.
Lake has 0.02 part DDD per million parts of water.
Grebes die of DDD poisoning.
Microscopic life has 5 parts DDD per million parts of organisms.
Fish has 200 parts DDD per million parts of organism.

Figure 9–3

The death of grebes from DDD poisoning was dramatic! Other alarming things were happening to life on our planet, as shown in Figure 9–4. The problems were caused by persistent pesticides.



Several types of algae in the oceans all over the world had tiny amounts of DDT. Where there was DDT, the plants produced less oxygen. They also didn't reproduce as fast as they normally did. Small fish eat algae. Fewer algae — fewer fish? Less oxygen? Maybe.



Many birds began laying eggs with thin shells. When the bird tried to hatch the eggs, the eggs broke. Fewer babies, fewer birds. Birds eat insects. Some birds eat mice and rats. Fewer birds — more bugs, mice, and rats? Maybe.

Figure 9–4

★ 9–4. What are two bad "side effects" that DDT has had on animals?

9-4. DDT caused birds' egg shells to be too thin. The shells broke too soon and fewer birds survived to become adults. Some types of algae (a main food of fish) seem to produce less oxygen gas and reproduce themselves less in the presence of DDT. This robs fish of both food and some oxygen.

Soon more and more information on the dangers of DDT to life came to light. And in November 1969 the federal government banned the use of DDT in the United States, except in emergencies.

✓ 9–5. What might be an "emergency" that would allow the use of DDT again in this country?

9-5. DDT kills insects which spread some diseases. An epidemic of such a disease could be such an emergency. Drought or other natural disasters (flood, hail) could drastically reduce the harvest of a crop one year. Then, we could no longer afford to have some of the crop lost to insects which could be killed by DDT.

✓ 9–6. DDT kills insect pests that feed on food crops. What could result to food crops if DDT were banned everywhere in the world? 9-6. The amount of food on tables around the world could decrease.

When scientists developed DDT, few people thought about its long-range effects. Even now there are some scientists who feel that the dangers of DDT have been exaggerated. They point out that millions of lives have been saved by DDT. Malaria has been wiped out from many parts of the world. These scientists think that the good that DDT does outweighs its harm.

✓ 9–7. What steps would you take before allowing a new insecticide to be used in this country? 9-7. Answers will vary.

✓ 9–8. DDT is banned in the United States. Do you agree or disagree with this action? Explain your answer.

9-8. Answers will vary.

Doing What Comes Naturally

ACTIVITY EMPHASIS: The control of insect populations without the use of insecticides.

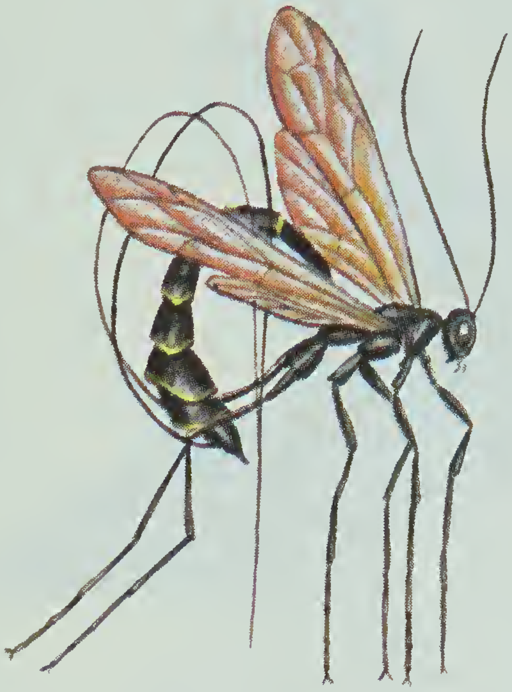
MATERIALS PER STUDENT UNIT
None.

Insects make up the largest group of animals on Earth. In fact, over 900,000 different species have been identified. Of these only about one percent are harmful. One percent of 900,000 doesn't seem like much. But the insects in this group can be very destructive. They carry disease, spoil food crops, and eat away buildings. They must be controlled. There are ways of controlling insect pests without using insecticides.

This activity looks at how pests are controlled in nature by other insects and birds. It also deals with how certain plants can be used to control common house and garden pests.

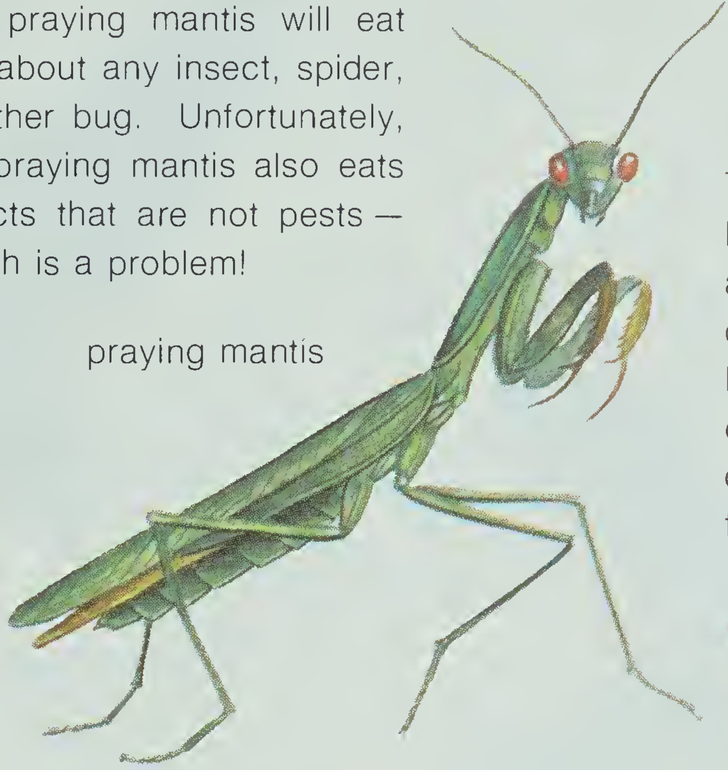
INSECTS THAT PREY UPON PESTS

Many insects prey on each other. One is the predator, the one that eats — the other is the prey, the one that is eaten. The predators also use the nymphs, larvae, and adults of other insects for food for their young. Figure 10–1 shows some predators.



ichneumon

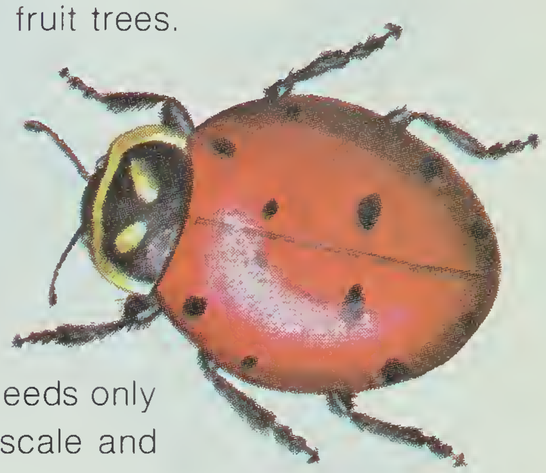
The praying mantis will eat just about any insect, spider, or other bug. Unfortunately, the praying mantis also eats insects that are not pests — which is a problem!



praying mantis

cicada killer wasp

The cicada killer wasp is a large wasp that paralyzes the adult cicada by stinging. The cicada is put into a hole dug by the wasp. Here the larva of the wasp feeds on the cicada. Cicadas damage young fruit trees.

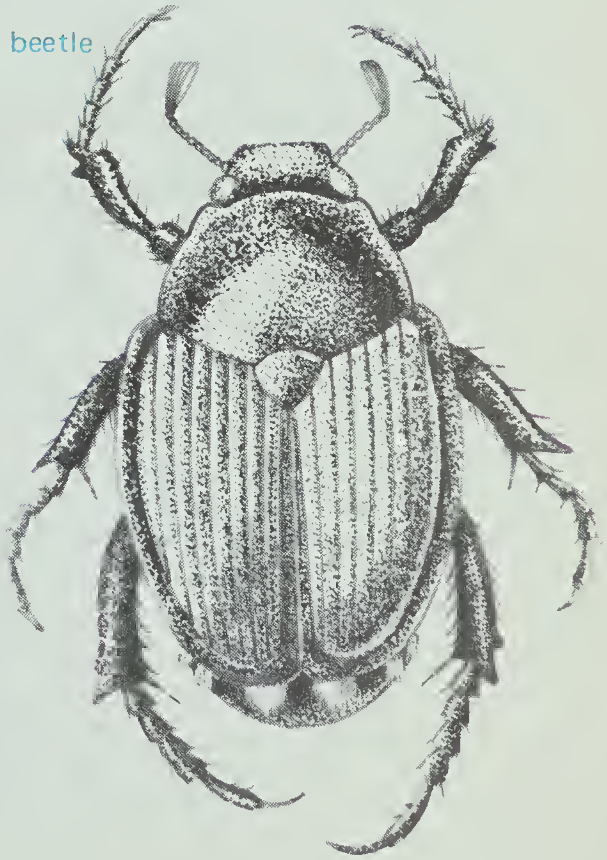


ladybird beetle

The ichneumon (ik-NEW-mon) is related to bees and wasps. The female has a long, spear-like ovipositor to deposit its eggs on other insects. The larvae of the ichneumon feed on caterpillars and the larvae of beetles, flies, and other pests.

The ladybird beetle feeds only on insects such as scale and aphids, which cause damage to plants.

Figure 10–1



Japanese beetle

The use of insect enemies can be successful in controlling the Japanese beetle. The beetle feeds on food crops and fruit trees. An Oriental wasp has been used to control the beetle. The wasp paralyzes the beetle larva with its sting. Then the wasp lays its egg on the beetle larva. When the wasp egg hatches, the beetle larva is its first meal.

10-1. Insects known to eat pests (but not crops) could be introduced to a field

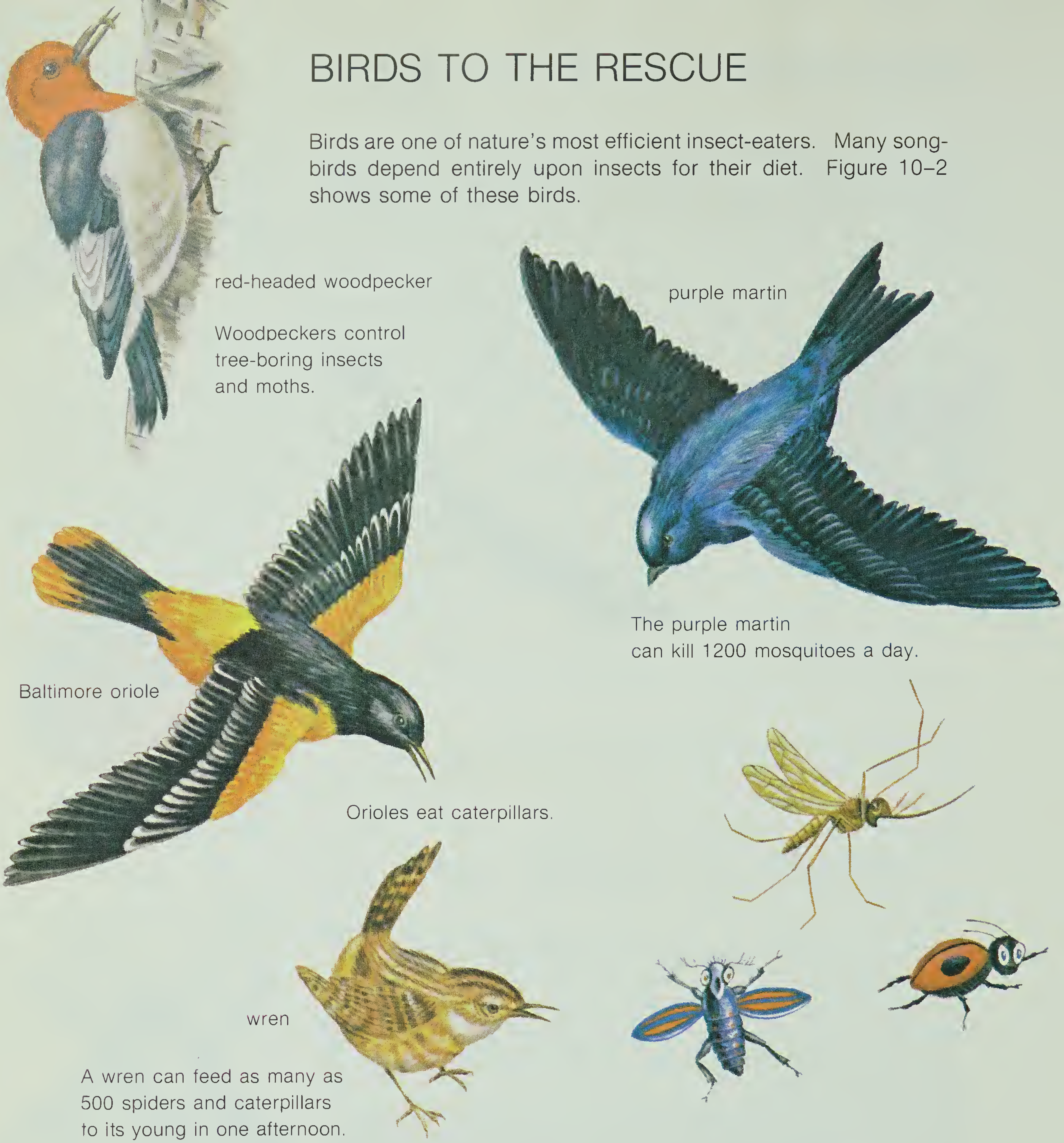
★ **10–1. Explain how the "normal" diet for many insects can be helpful in controlling insects that are harmful to our food crops.**

infested with such insect pests. The pests would be eaten and the crops saved.

✓ 10–2. Describe how the ichneumon preys upon other kinds of insects. 10-2. Its larvae eat larvae of other insects.

BIRDS TO THE RESCUE

Birds are one of nature's most efficient insect-eaters. Many songbirds depend entirely upon insects for their diet. Figure 10–2 shows some of these birds.



red-headed woodpecker

Woodpeckers control tree-boring insects and moths.

purple martin

The purple martin can kill 1200 mosquitoes a day.

Baltimore oriole

Orioles eat caterpillars.

wren

A wren can feed as many as 500 spiders and caterpillars to its young in one afternoon.

Figure 10–2

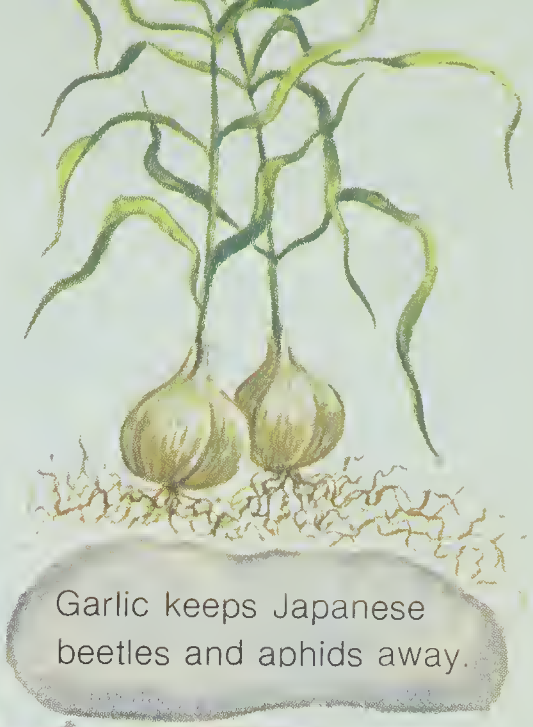
★ 10–3. Many birds are protected from hunters by state laws. How does protecting birds help the environment?

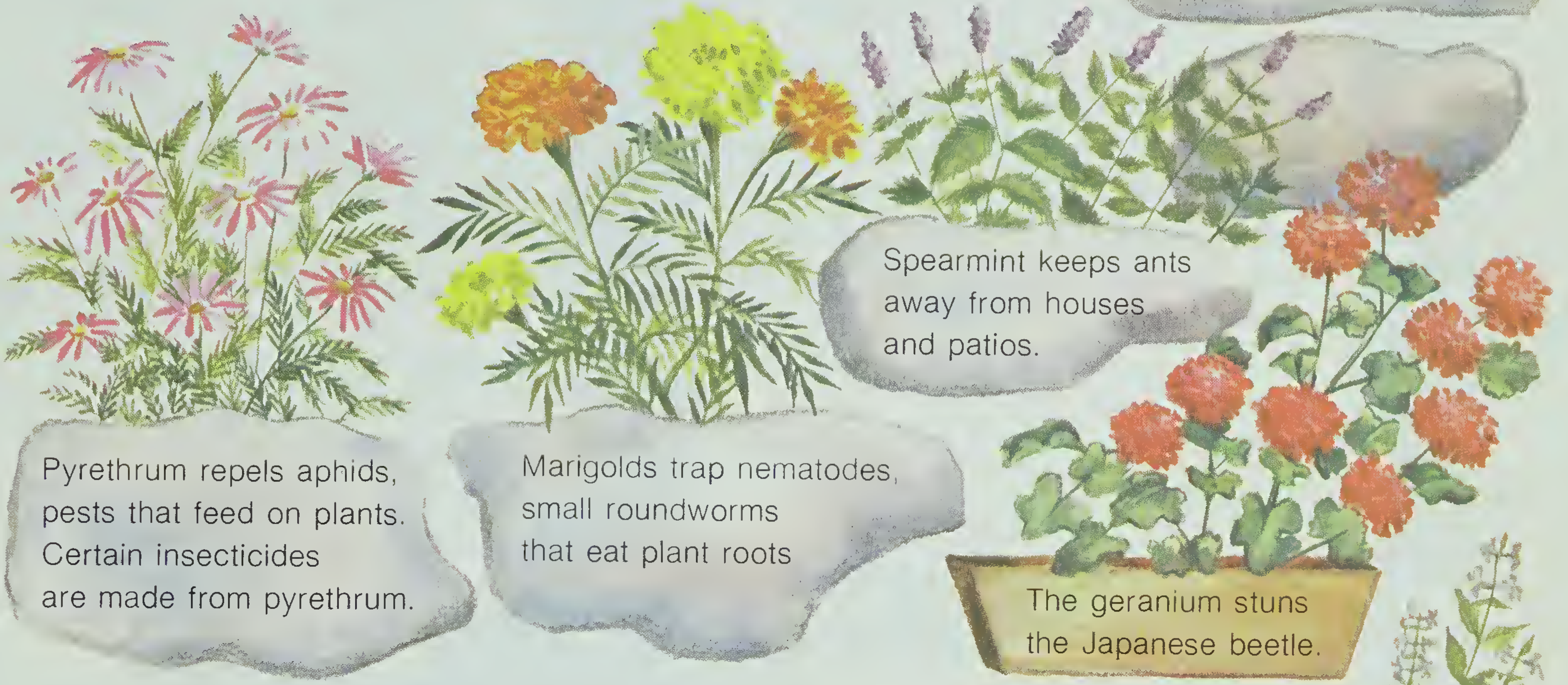
10-3. It ensures that there are enough birds to keep the insect pest population under control.

PLANTS HELP CONTROL HARMFUL INSECTS

Certain plants are very unpopular with insect pests. These plants can help control insect pests around the home or garden.

In addition, they can help keep the use of insecticides to a minimum. Some plants contain chemicals that injure the insects that feed upon them. Others contain chemicals that repel insects. Figure 10–3 shows some of these plants.


Garlic keeps Japanese beetles and aphids away.


Spearmint keeps ants away from houses and patios.
Pyrethrum repels aphids, pests that feed on plants. Certain insecticides are made from pyrethrum.
Marigolds trap nematodes, small roundworms that eat plant roots
The geranium stuns the Japanese beetle.

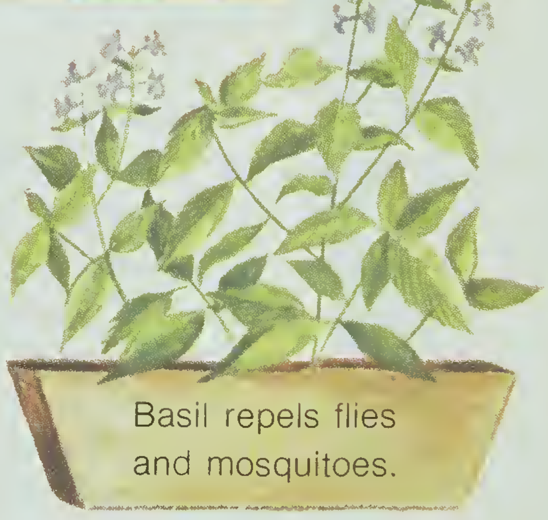

Basil repels flies and mosquitoes.

Figure 10–3

★ **10–4. What are two ways a plant can keep insects away from your home or garden?** 10-4. Some plants poison insects that eat them. Others simply repel some insects.

✓ 10–5. What plants could you put near doorways and other openings near the ground to repel ants? 10-5. Spearmint.

✓ 10–6. What are some of the advantages of using "natural" enemies of bugs instead of insecticides?

10-6. There is less danger of harming beneficial life forms. Insecticides can be harmful to use if we're not careful. There is less risk in using natural controls.

✓ 10–7. Make a list of some of the natural enemies of insect pests around your home, school, or nearby park.

10-7. Answers will vary.

✓ 10–8. Observe closely some of these natural enemies. Keep a record of what you see. How many insects does a bird catch in a 30-minute period of time? How many insects does a spider have trapped in its web?

10-8. Answers will vary.

advanced

Activity 11 Planning

Activity 12 Page 55

Objective 10: Name the three body regions of a grasshopper and the parts which attach to each.

Sample Question: Match the body parts in List A to the body regions where they attach in List B.

List A
a. legs
b. antennae
c. wings

List B
1. head
2. thorax
3. abdomen

Objective 11: Tell which characteristics are true of all arthropods and which are unique to grasshoppers.

Sample Question: To be classified as an arthropod, an animal must have
a. long, straight wings.
b. an exoskeleton.
c. three pairs of legs.
d. green colored bodies.

Activity 13 Page 61

Objective 12: Tell how Von Frisch's study of the language of bees used experimental design.

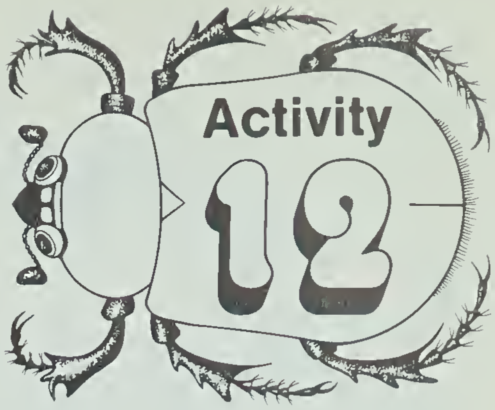
Sample Question: The "design" of an experiment is how the experimenter plans to
a. define the hypothesis.
b. test the causes of several variables at one time.
c. test the hypothesis or hypotheses.

Answers

10. a2, b1, c2   11. b   12. c

Dissecting a Typical Insect

ACTIVITY EMPHASIS: The structure and function of the principal parts of the grasshopper and how these form a basis for classification.



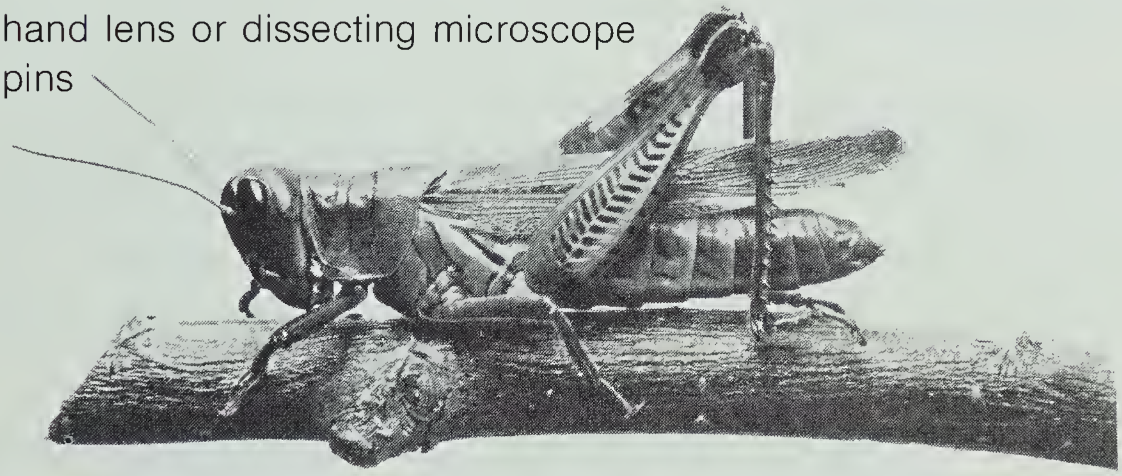
As you examine a whole and dissected grasshopper in this activity, you'll observe structures that are typical of most insects. But your aim should be more than just to identify the body parts. Try to figure out how the grasshopper's structure is related to its function. How does its structure make the insect so biologically successful?

You'll begin by examining the whole grasshopper. You will need the following items:

1 large grasshopper (freshly killed or preserved)
hand lens

For the dissection, you will need the following items:

1 large grasshopper (from above)
dissection kit
dissection pan or corkboard
razor blade
hand lens or dissecting microscope
pins



Biologists classify plants and animals on the basis of structure. Organisms are grouped according to similarities of parts. Living things are commonly divided into two kingdoms: the plant kingdom and the animal kingdom. Each kingdom is subdivided into many phyla, and the phyla are divided into classes.

One class of animals is called *Insecta,* which includes all the insects. To be classified an insect, an animal must have the following characteristics: (1) a body divided into three divisions — head, thorax, and abdomen; and (2) six jointed legs. Insects usually also have two pairs of wings, two kinds of eyes — simple and compound eyes, and one pair of antennae. The grasshopper is a typical insect.

MATERIALS PER STUDENT UNIT
dissection kit
dissection pan or corkboard
grasshopper, large
hand lens or dissecting microscope
pins, straight
razor blade, single edge

A. Examine your grasshopper and locate the structures shown in Figure 12–1. Answer Questions 12–1 through 12–10 as you work.

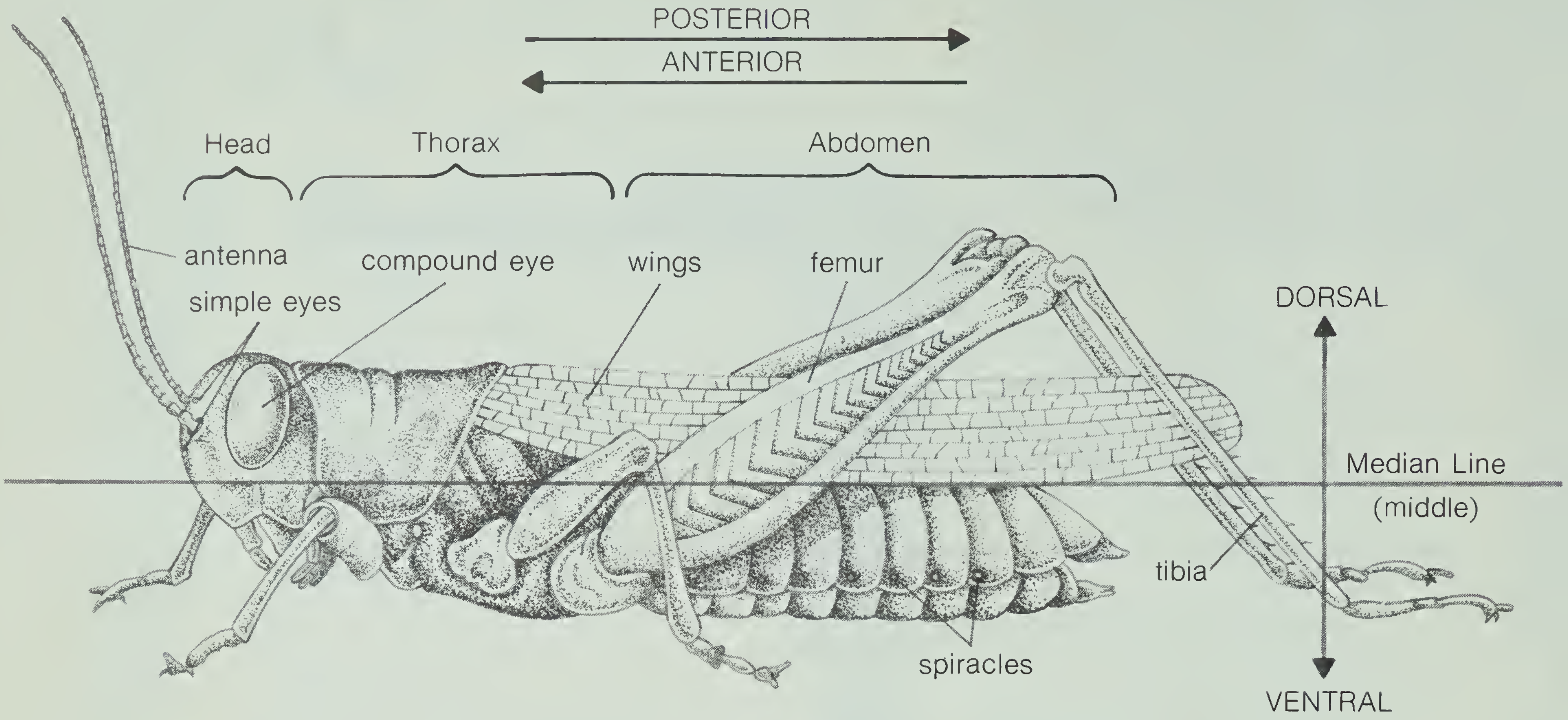


Figure 12–1

The arrows at the top of Figure 12–1 show directions used for body location. A structure near the head is said to be *anterior*. One located toward the tail end is *posterior*. The top of the body is the *dorsal* surface; the bottom is the *ventral* surface. In a human, the backbone side is *dorsal*, the front of the body is *ventral*.

✓ 12–1. Are the grasshopper's legs attached to the ventral or dorsal part of the body? 12-1. Ventral.

✓ 12–2. Are the legs anterior or posterior? 12-2. Anterior.

Insects, like many other animals, have a segmented body. This means that the body develops from separate parts, or segments, which later become specialized in the adult.

✓ 12–3. How many segments form the grasshopper's thorax?

12-3. Most grasshoppers have three segments.

★ **12–4. What evidence do you find to classify your grasshopper as an insect?** 12-4. Six jointed legs and three body parts. It also has two kinds of eyes, one pair of antennae, and two pairs of wings.

Male and female grasshoppers differ in the posterior structure of the abdomen. Figure 12–2 shows the ovipositor (egg-laying) structures of the female grasshopper.

The male grasshopper has similar structures, but there is a clear difference that you can identify. Examine other grasshoppers until you're sure you can see the difference between male and female.

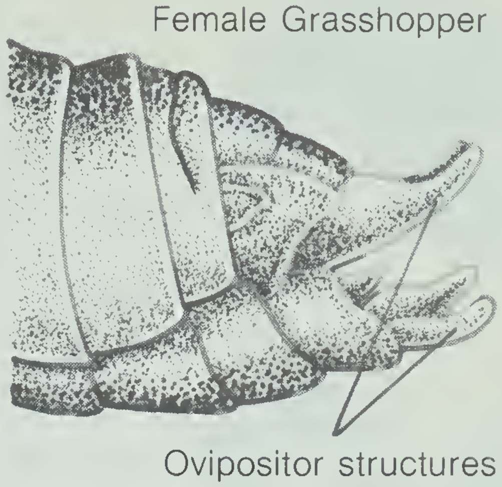


Figure 12–2

✓ 12–5. Is your grasshopper male or female?

12-5. Answers will vary.

✓ 12–6. Grasshoppers are good jumpers. How does their leg structure indicate this?

12-6. Their longest legs seem to have much muscle. Also they are long enough to give the grasshopper plenty of leverage to jump great distances.

The class *Insecta* is further subdivided into various orders. One order of class *Insecta* is *Orthoptera*, which means "straight-winged." Members of *Orthoptera* have four long, straight wings. The front pair are somewhat hard and leathery. The rear wings fold like a fan back to the body when closed, and are thin and transparent.

✓ 12–7. Carefully extend the wings along one side of the grasshopper. Describe the appearance and texture of the wings.

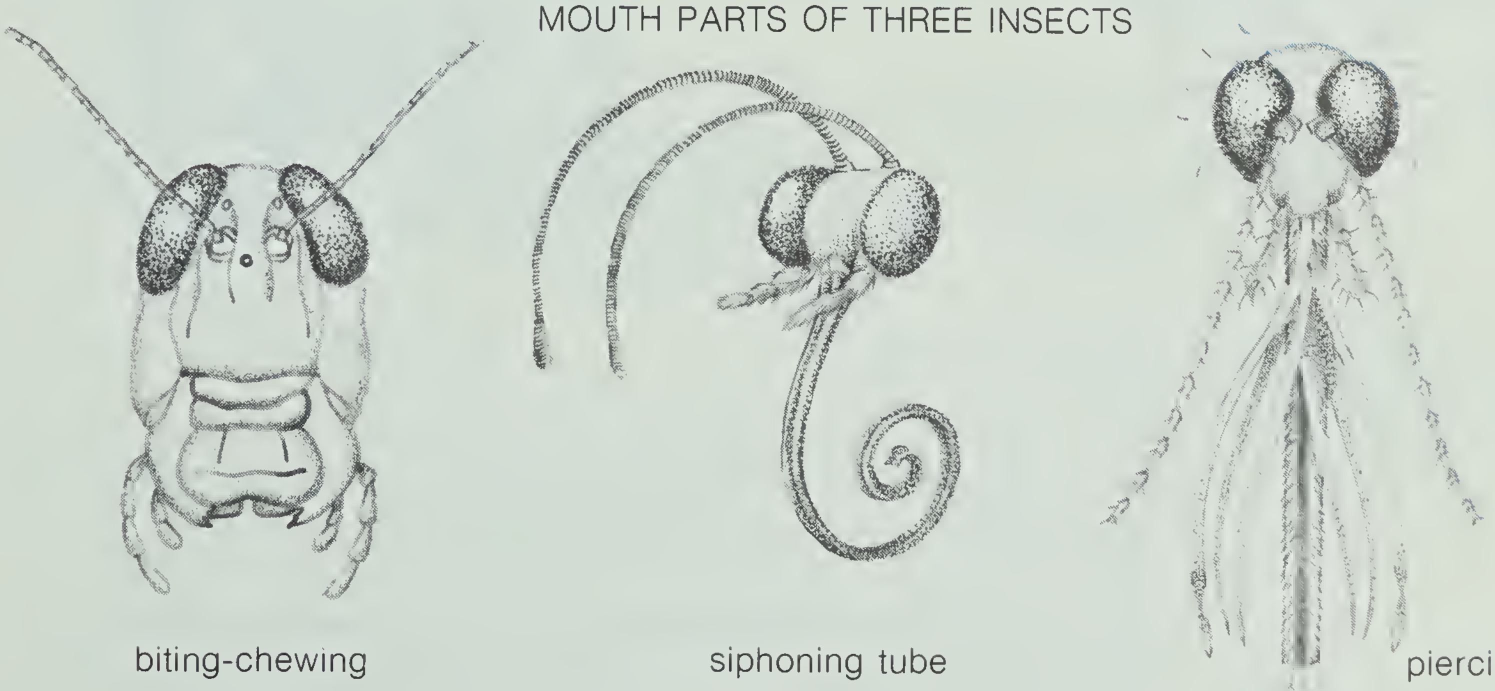
12-7. The posterior wings are thin and you can see through them. The anterior pair are thicker, hard, and like leather.

✓ 12–8. What do you think is the function of the forewings — the anterior pair?

12-8. The anterior wings probably protect the other wings from damage. The posterior wings are used for flight and if a predator damaged these, the grasshopper couldn't fly.

An insect's mouth parts indicate the way it feeds. Figure 12–3 shows three basic types of mouth parts.

MOUTH PARTS OF THREE INSECTS



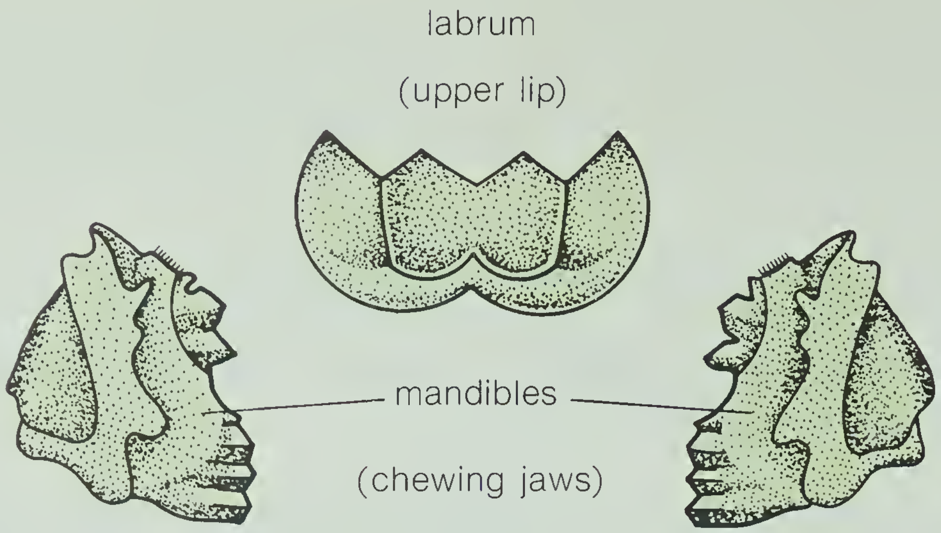
biting-chewing (grasshopper)

siphoning tube (butterfly)

piercing-sucking (mosquito)

Figure 12–3

B. Use a probe to open the grasshopper's mouth and locate its mouth parts. Refer to Figure 12–4 as you work.



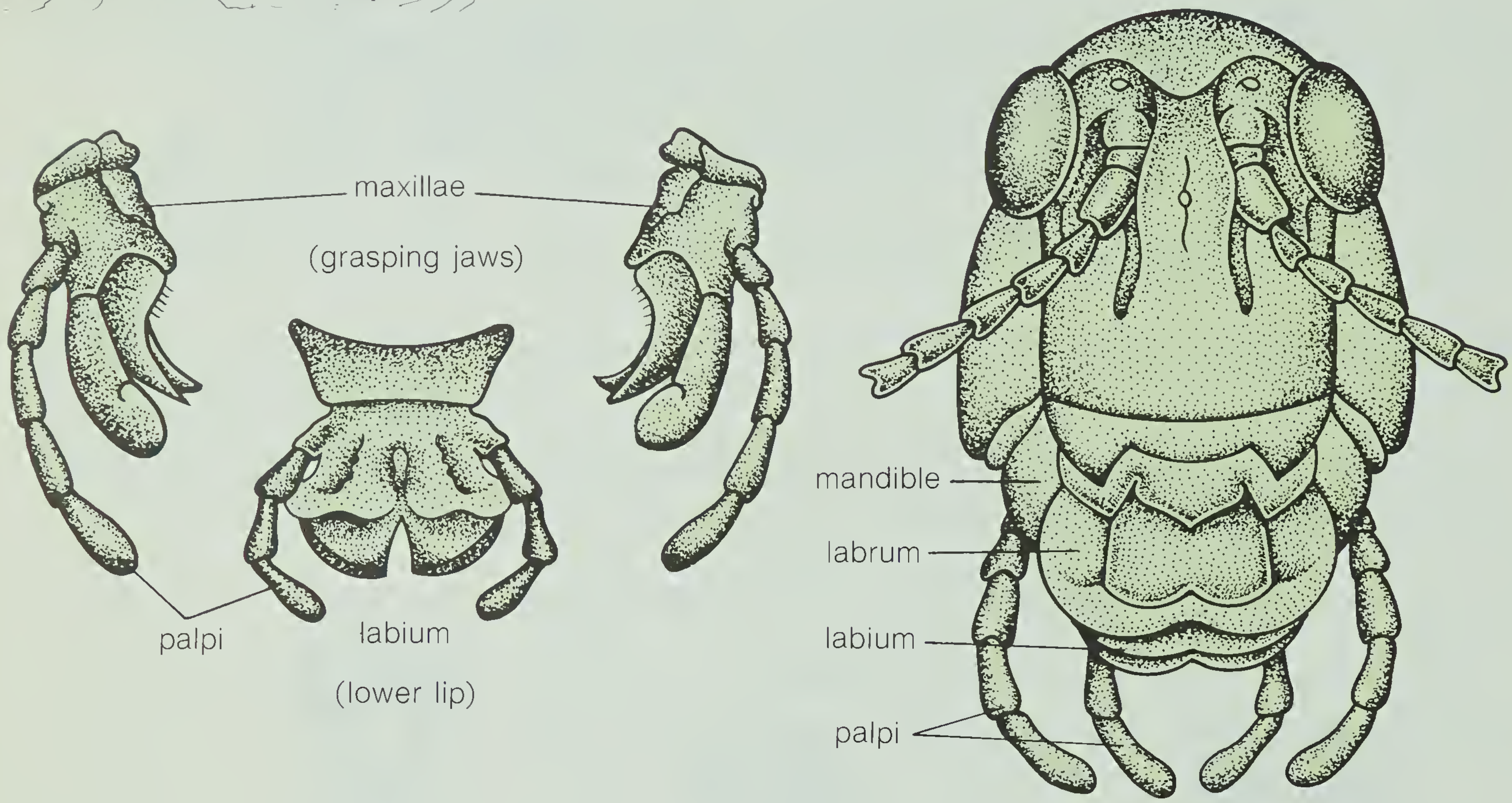


Figure 12–4

12-9. It has jaws designed for grasping food. It has other jaws for chewing food. It also has parts to bring food to the mouth.

✓ 12–9. Another characteristic of insects of the order *Orthoptera* is mouth parts adapted for biting and chewing. What type of mouth parts does your grasshopper have?

12-10. It has two pairs of long, straight wings. It has a mouth designed for biting and chewing food.

★ **12–10. List the features which you have found that classify the grasshopper as a member of the order *Orthoptera*.**

You will now dissect the grasshopper.

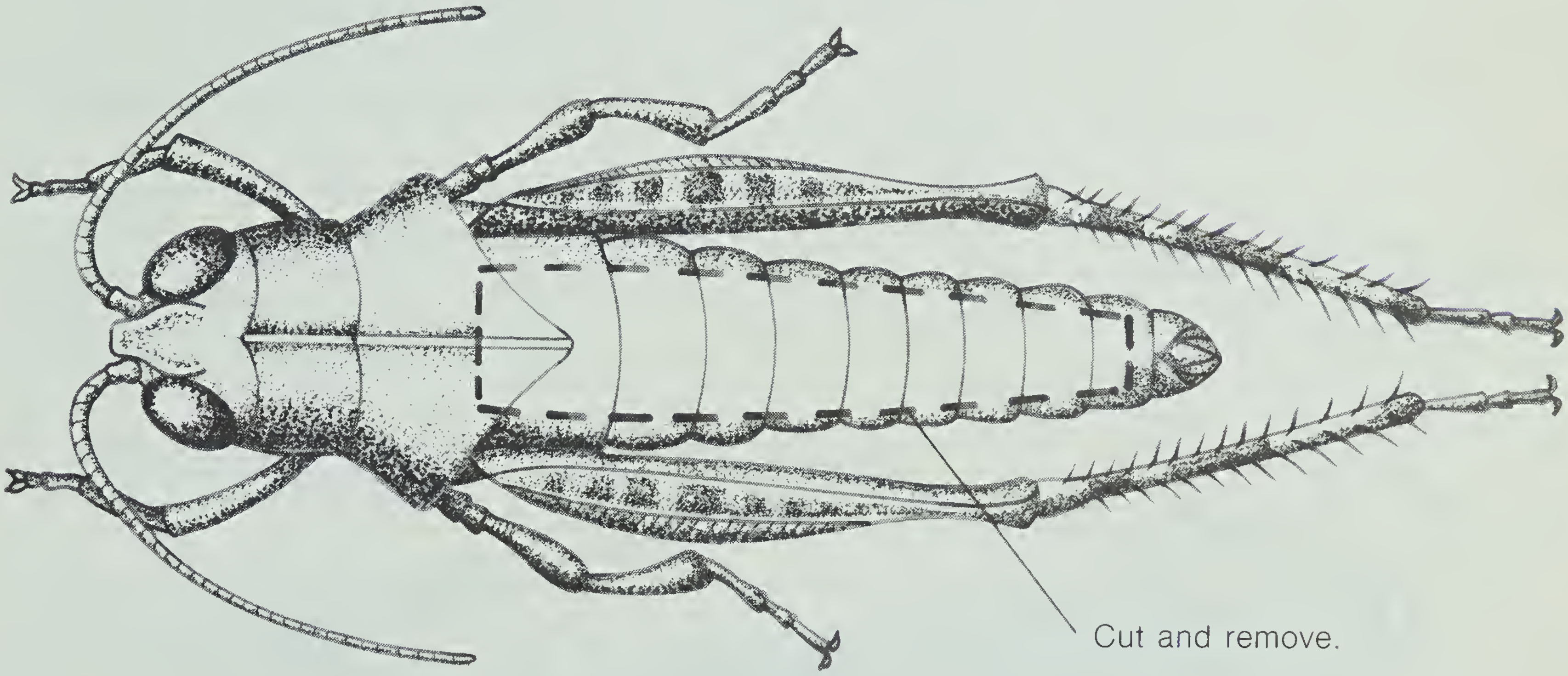
C. Begin the dissection with the grasshopper's head. Using a razor blade, slice a thin layer from the surface of one of the compound eyes. Examine this layer with a hand lens or dissecting microscope. Make a sketch of what you see.

✓ 12–11. What kind of image do you think this type of eye forms?

12-11. It probably forms many images of the same object, since it is composed of many lenses.

A compound eye has many lenses rather than one lens, such as your eyes have. The image formed is probably like a mosaic, a picture made from thousands of pieces. This type of eye is useful for detecting motion. It also enables the insect to see in almost every direction at once.

At the beginning of this activity you learned that the animal kingdom is divided into large groups called phyla. One of these is the phylum *Arthropoda*. A member of this phylum is called an *arthropod*. An arthropod has its main nerve cord close to the ventral surface. It also has a skeleton on the outside of its body called an *exoskeleton*. An arthropod's body is usually divided into sections or segments, to which jointed appendages (legs, pincers, wings) are attached.



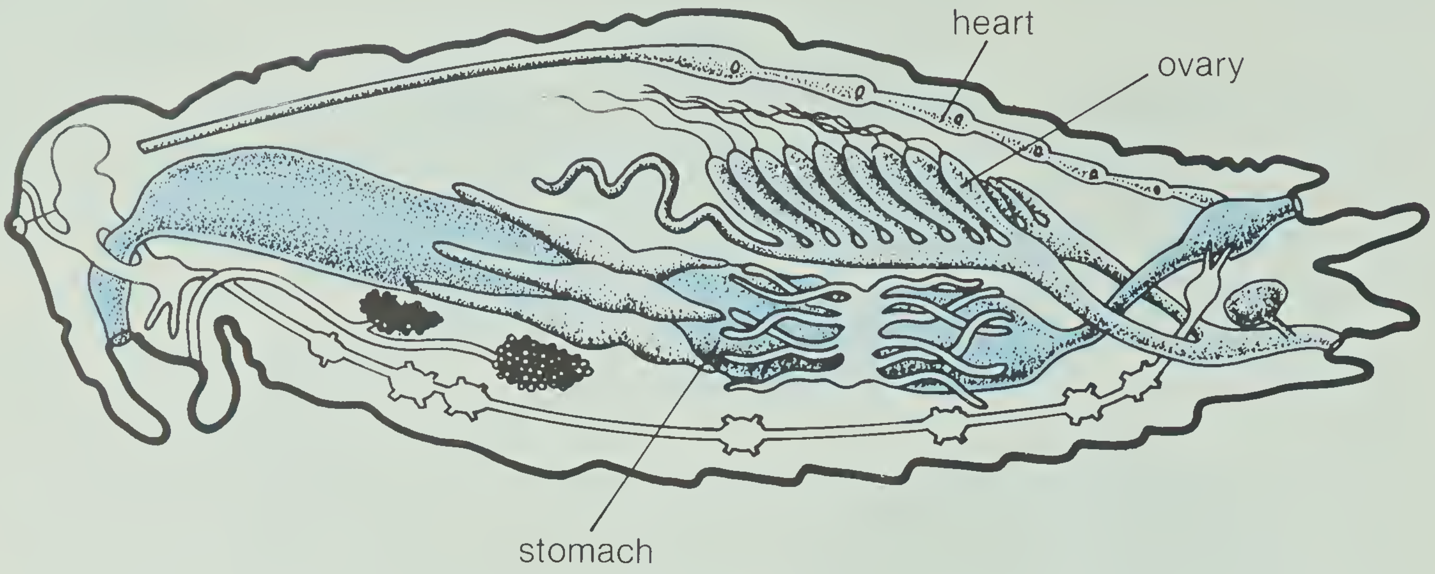
D. Remove the wings. Lay the specimen dorsal side up in the dissecting pan. Cut through each side of the posterior abdomen and thorax as shown. Then carefully remove the dorsal part of the exoskeleton.

★ 12–12. How does the skeleton of the grasshopper differ from your skeleton?

12-12. Its skeleton surrounds its body, thereby protecting it. Your body surrounds your skeleton and is supported by your skeleton.

E. Locate the abdominal parts shown in the illustration. If the specimen is a female, look inside the anterior end of the abdomen. You may find a mass of yellow ovaries obscuring everything. Push them aside to find the dark-colored stomach.

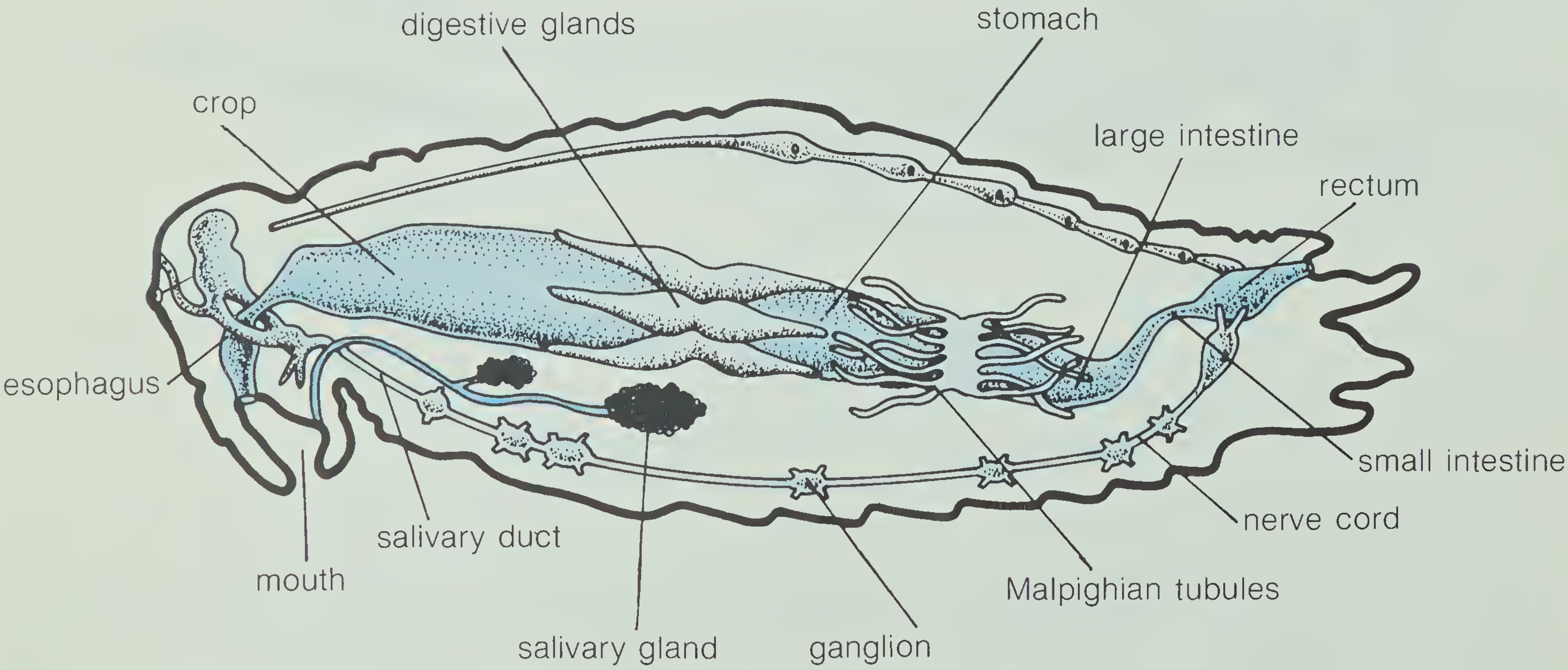
FEMALE GRASSHOPPER



F. Use the drawing to locate the digestive system parts. In the thorax is the crop, a food-storage sac. In this region, locate the digestive glands, which are cone-shaped pouches. Next, find the stomach, which leads into the intestine.

Find the Malpighian tubules, which do the same job as our kidneys. These tubules remove wastes from the grasshopper's body.

Along the ventral region of the abdomen, you may find enlargements of the nerve cord. These are called *ganglia.* Many nerves branch from the ganglia to tissues. Trace the nerve cord to the head.



✓ 12–13. What evidence of a brain do you find in the grasshopper? 12-13. A long, thin filament with smaller threads.

★ **12–14. What characteristics indicate a grasshopper should be classified as an arthropod?**

12-14. Its body has segments to which legs and wings are attached. It has an exoskeleton. It also has a ventral nerve cord.

✓ 12–15. Match each function below with one or more major body regions. Write your answers on a separate sheet.

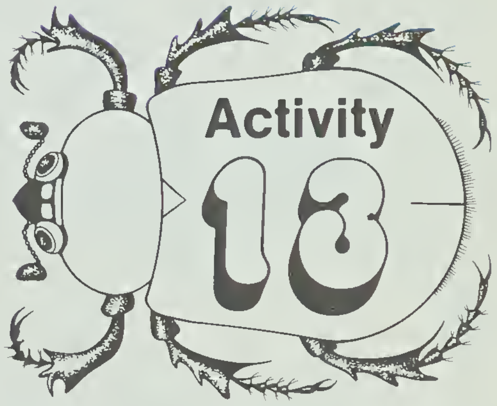
Function	*Body Region*
a. Senses	1. Head
b. Reproduction	2. Thorax
c. Waste removal (excretion)	3. Abdomen
d. Movement	
e. Digestion	

12-15.
a - 1
b - 3
c - 3
d - 2
e - 3

Dissection of an animal can show you many things. Your dissection of the grasshopper not only showed you the grasshopper's parts, but it served as a basis for classifying the grasshopper by its structure. The grasshopper is classified as follows:

Kingdom: *Animalia*
Phylum: *Arthropoda*
Class: *Insecta*
Order: *Orthoptera*

The Secret Language of Bees



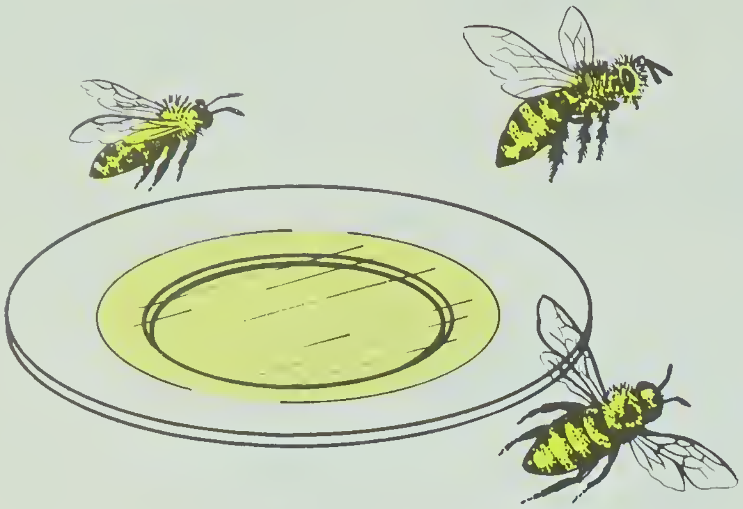
ACTIVITY EMPHASIS: The study of communication among bees as an example of the control of variables in an experimental design.

In Activity 8, you heard how male crickets communicate with other crickets. Communication among most animal groups is important. But it is especially important to animals that live in societies, such as ants, bees, and people.

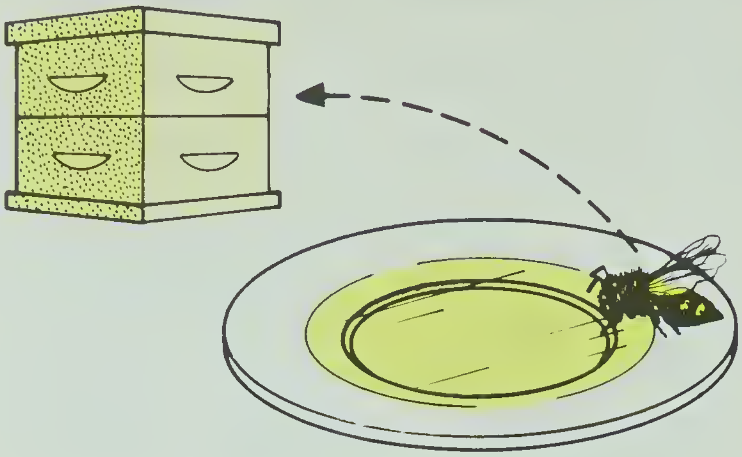
Each member of a society usually has a special job that helps the entire society. And to work together, the members must be able to communicate with each other. Crickets send out various calls that have special meaning — from courting to fighting. But calls are not the only way animals can communicate. Bees, for instance, have a fascinating language that does not depend on sound.

MATERIALS PER STUDENT UNIT
None.

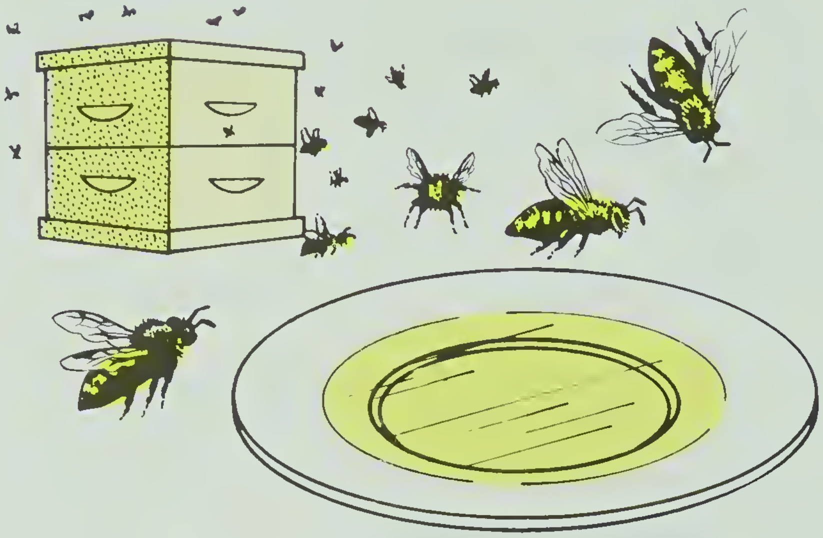
Since the 1920's, Karl von Frisch, an Austrian biologist, has studied how bees communicate. Figure 13–1 shows some of his early observations of bee behavior.



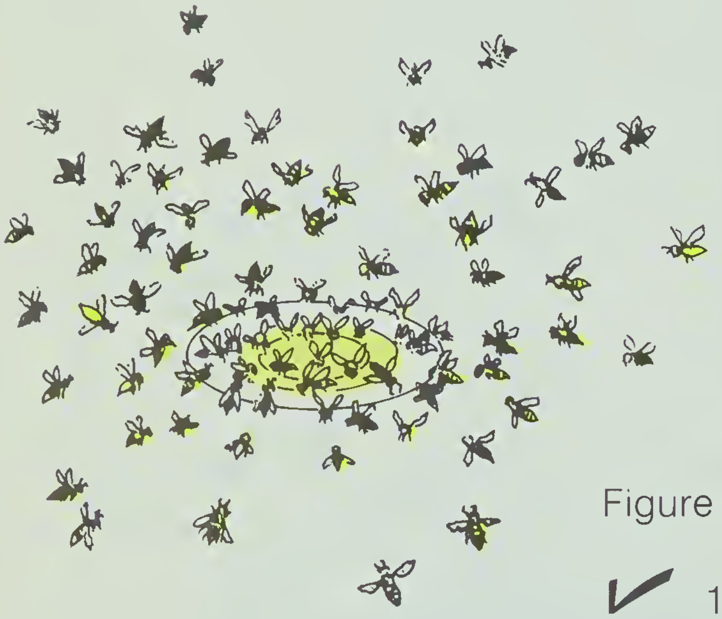
1. A dish of sugar water placed near a beehive may not be found by the bees immediately.



2. Sooner or later, one of the bees will find the food and take some back to the hive.



3. Within a few minutes, other bees will leave the hive and fly to the dish of sugar water.



4. In an hour, hundreds of bees may be at the dish.

Figure 13–1

✓ 13–1. What do von Frisch's observations suggest?

13-1. The first bee must somehow have communicated information about the location of the food.

Von Frisch then designed several experiments to determine the following: (1) if communication was really taking place between bees, and (2) what sort of information was being exchanged. The word "design" means a plan of action — a plan for achieving some goal.

To understand what makes up an experiment, you must know the steps involved. For a view of what's involved in an experiment, look at *Resource Unit 15*.

Von Frisch was sure that the first bee had somehow passed along the information about where the food was to the other bees. But how? To find out, von Frisch constructed a glass-sided beehive. Now he could watch the actions of a bee that had discovered food and returned to the hive.

Again von Frisch set out a dish of sugar water. When the dish was discovered, he marked the discovering bee with a dab of paint. Then he hurried back to the hive to watch what happened.

★ **13–2. What was von Frisch's hypothesis?**

✓ 13–3. Why did von Frisch want to observe the behavior of the marked bee when it returned to the hive?

★ **13–4. Von Frisch's experiment used several variables. What were they?**

13-2. That bees communicate among themselves.

13-3. He hypothesized that it was the *marked* bee which started the communication.

13-4. *Distance from the beehive:* the shortest distance by flight between the food and the beehive. *Direction from the beehive:* the food is either on the sunny side of the hive or it's on the side away from the sun. *Behavior of the bee:* the movements of the bee in the beehive who has just returned from the food. *Behavior of the other bees:* the routes followed by the other bees from the beehive to the food.

Here's what von Frisch observed when he returned to the hive.

1. If the food was close to the hive (within 100 metres), the marked bee would do a "round dance." That is, it would turn in full circles, as shown in Figure 13–2.

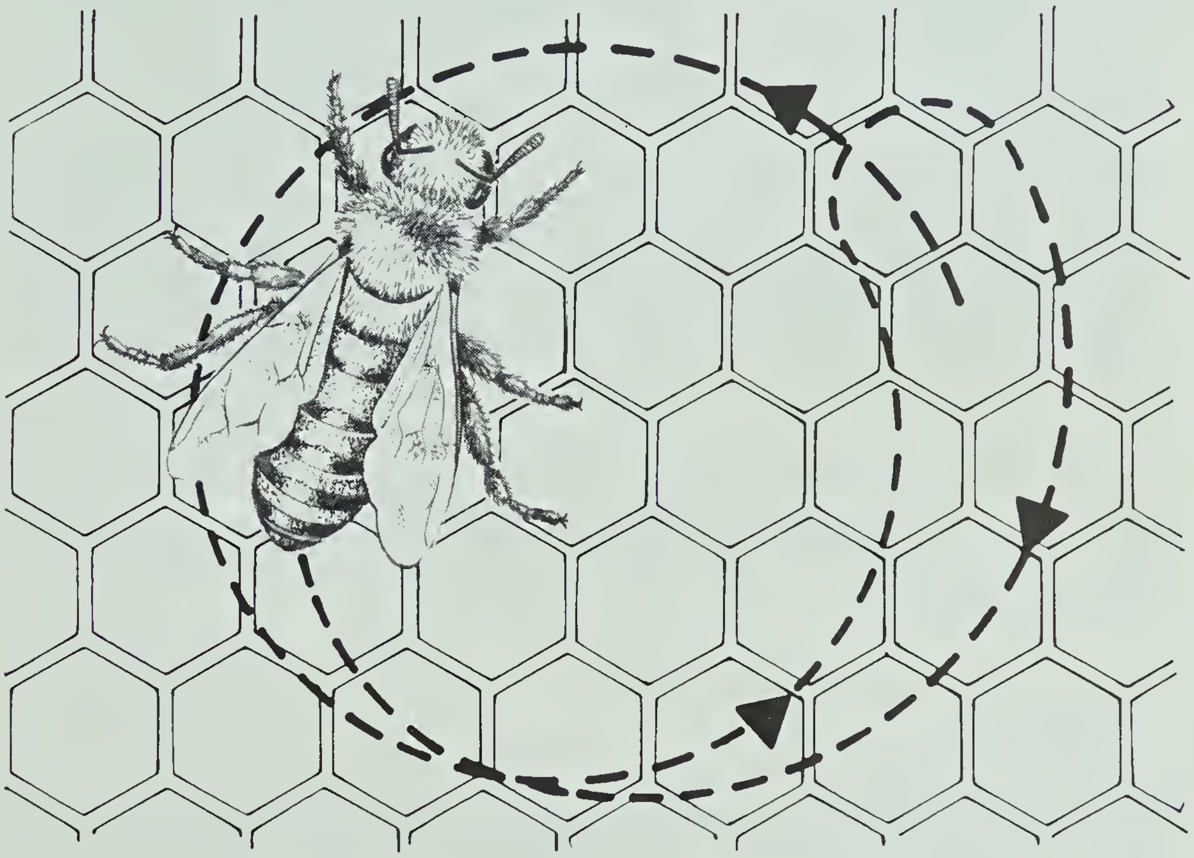


Figure 13–2

Some bees responded to the dance. They touched the dancer and left the hive. They searched the immediate area until the food was located.

2. If the food was farther away than some 100 metres, the returning bee would do a "tail-wagging dance." The bee would run a short distance and wag its tail end from side to side (see Figure 13–3). The bee would then circle back to the starting point and repeat the short run.

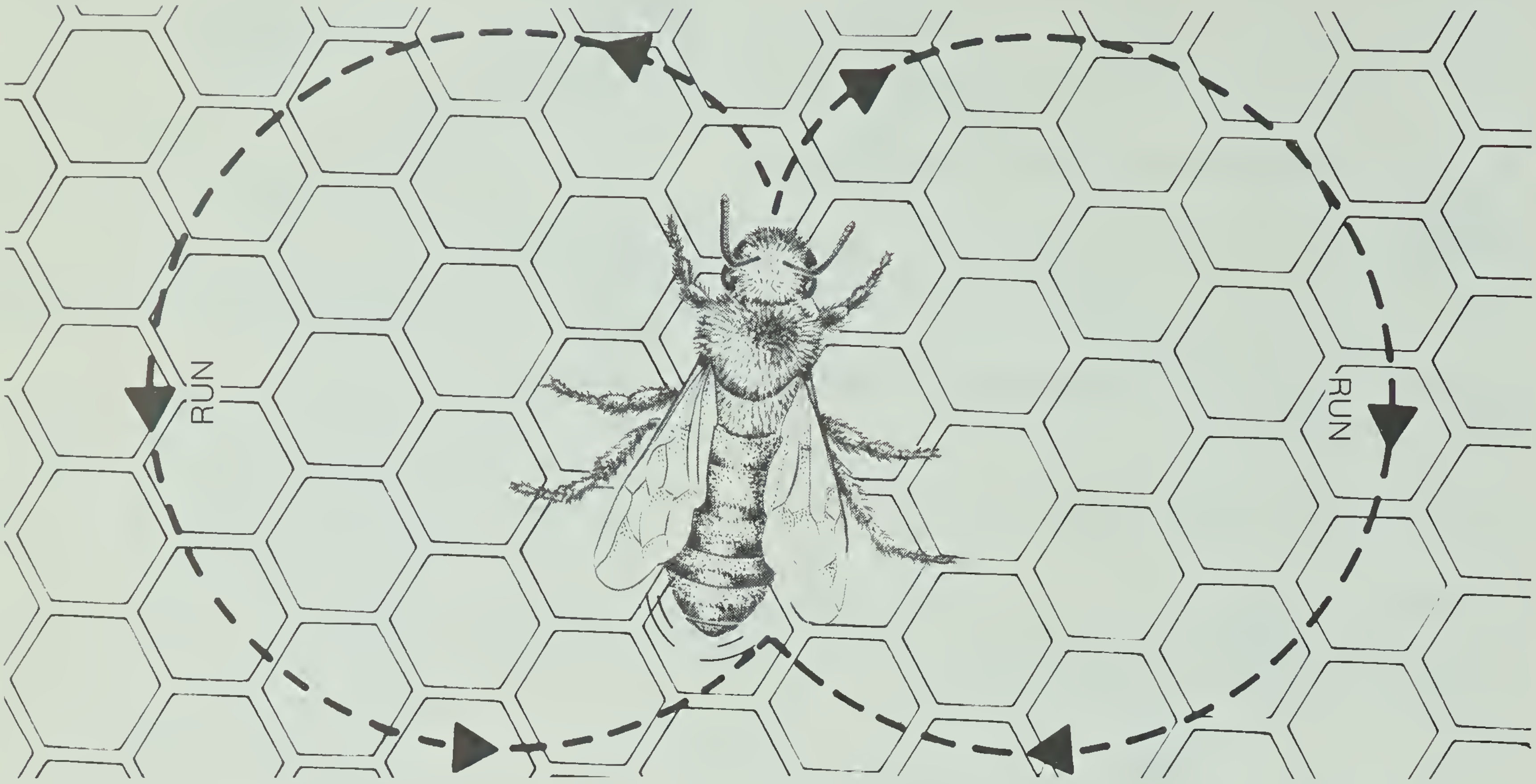


Figure 13–3

3. As the food source was moved farther and farther away from the hive, less tail wagging and fewer runs were observed in the returning bee's dance.

13-5. He wanted to see how the first bee told the others how far away the food was.

✓ 13–5. Why did von Frisch place the food source (sugar water) at different distances from the hive?

13-6. Possible control: the movement of bees returning to the hive who hadn't found food.

✓ 13–6. If you were to design a similar experiment, what would be your control?

Study the information that accompanies Figures 13–1 and 13–2 carefully.

13-7. By body movements. For each range of distance, its body movement would be different.

✓ 13–7. How might the marked bee communicate the *distance* to the food?

✓ 13–8. Describe an experiment design that could be used to determine if the bee could communicate the distance to the food source.

13-8. Move the sugar water to several distances and observe the dance of the returning bees.

✓ 13–9. Explain how you came to your conclusion in answering Question 13–7.

13-9. The bee did a round dance when the food was within 100 metres of the hive. It did a tail-wagging dance when the food was more than 100 metres from the hive. The further away the food was, the less tail wagging and runs the bee made. So the bee's actions seem to depend on the distance to the food.

Let's assume that every movement of the bee's dance means something. Review the different dances.

✓ 13–10. Suggest how the *amount* of food might be communicated by the returning bee. 13-10. The size of the circles or loops run by the bee might tell how much food was there.

✓ 13–11. Suggest how the *kind* of food might be communicated by the returning bee. 13-11. The directions traveled around the loops could communicate the kind of food.

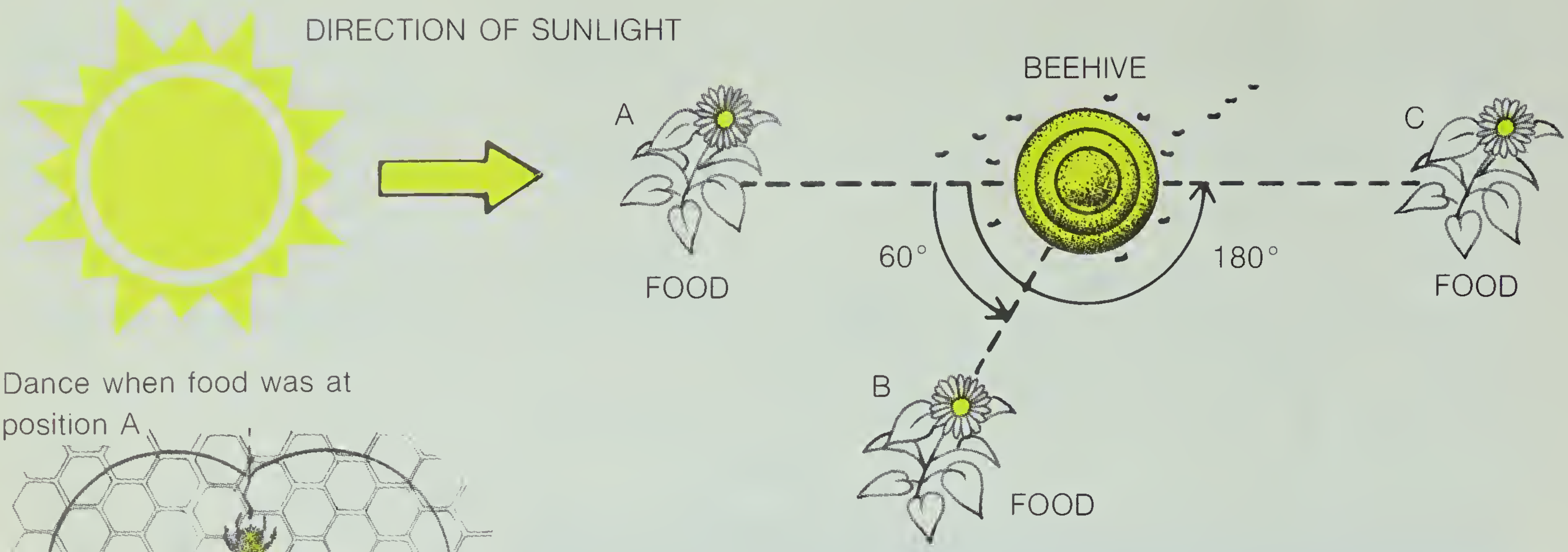
Von Frisch then noted another oddity. Bees that left the hive after a round dance had to search the immediate area for the food. But bees leaving after a tail-wagging dance were able to fly straight to the marked bee's food source. They ignored other dishes of sugar water that were placed nearer or farther in the same direction.

✓ 13–12. The observations in the above paragraph suggest the possibility of another independent variable influencing the bee's dance. What is that variable?

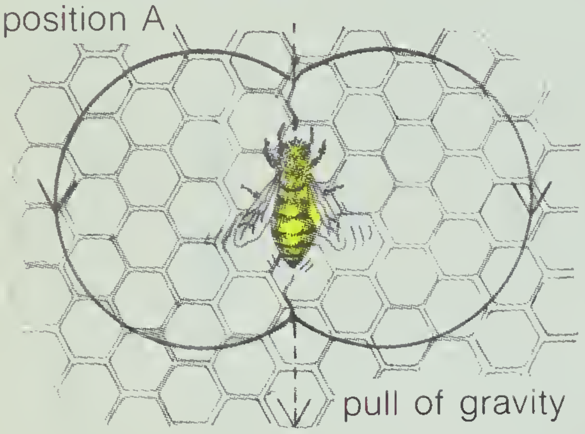
13-12. The direction of the food may affect the dance.

✓ 13–13. It appeared to von Frisch that the message communicated by the wagging dance must contain information about both direction and distance of the food source. Explain what led him to believe this.

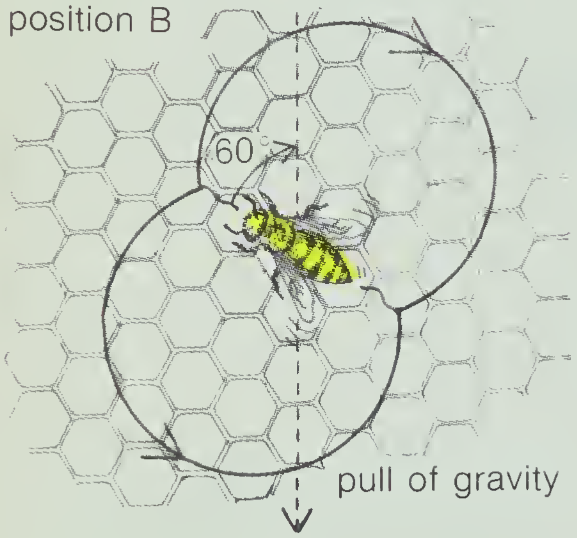
13-13. The amount of tail wagging and runs in the dance depended on the distance to the food. Only bees who saw the tail-wagging dance traveled in the proper direction to the food.



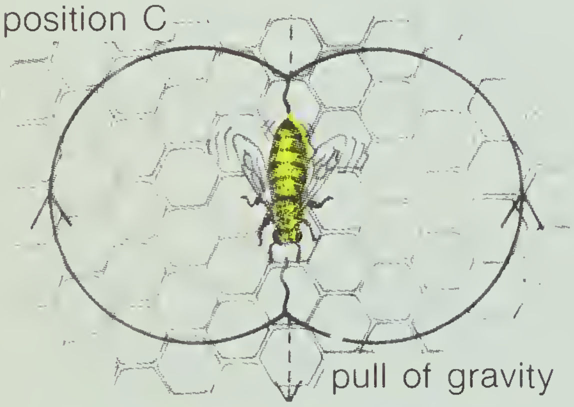
Dance when food was at position A



Dance when food was at position B



Dance when food was at position C



The pull of gravity is toward the center of Earth.

Figure 13–4

13-16. Factors which come to light during the experiment often can't be analyzed because the experiment wasn't designed to investigate them.

Von Frisch investigated this idea by placing the food source at different directions and distances from the hive and noting the sun's location in the sky. His results are shown in Figure 13–4.

✓ 13–14. Answer these questions by examining Figure 13–4:

a. Suppose the bee's short run in the wagging dance went directly up the side of the hive, against gravity. Where would the food be in relation to the sun's direction from the hive?

13-14. a. Toward the sun from the hive.

b. If the dance goes downward, directly toward the pull of gravity, where is the food? b. On the shady side of the hive.

✓ 13–15. For Dances A, B, and C to occur, food must be at least what distance from the hive? 13-15. 100 metres

★ **13–16. How one plans to test for the hypothesis is the "design" of an experiment. How could this design affect the analysis of the results of the tests?**

✓ 13–17. How could a preconceived opinion or a strong personal opinion influence the design of an experiment?

As you worked through this activity and answered the questions, you were involved in problem-solving. The information provided about von Frisch's study of bees allowed you to "look over his shoulder" and follow his reasoning. With any luck and some careful work, you too arrived at the point where you could say that bees communicate basic information to other bees about the direction and distance of a food source from the hive.

13-17. The experimentor might not recognize and control for some important side effects (other variables which might affect the outcome).

excursion

Activity 14 Planning

Keeping Flies From Breeding

Activity 15 Page 68

Houseflies are a very common insect pest. They don't bite or sting, but they can pass disease to humans. How and why they are disease carriers is explained in this excursion. How to control houseflies is also discussed.

Bug Self-Defense

Activity 17 Page 74

Many insects and bugs have ways to escape being eaten that are fantastic! This excursion takes a look at several of these methods.

Controlling Termites

Activity 16 Page 71

You may suspect that you have drywood termites in your home. In this activity, you'll learn how to identify and control termites.

Activity 15

Keeping Flies from Breeding

ACTIVITY EMPHASIS: How the housefly can pass disease to humans and methods of housefly control.

MATERIALS PER STUDENT UNIT
None.

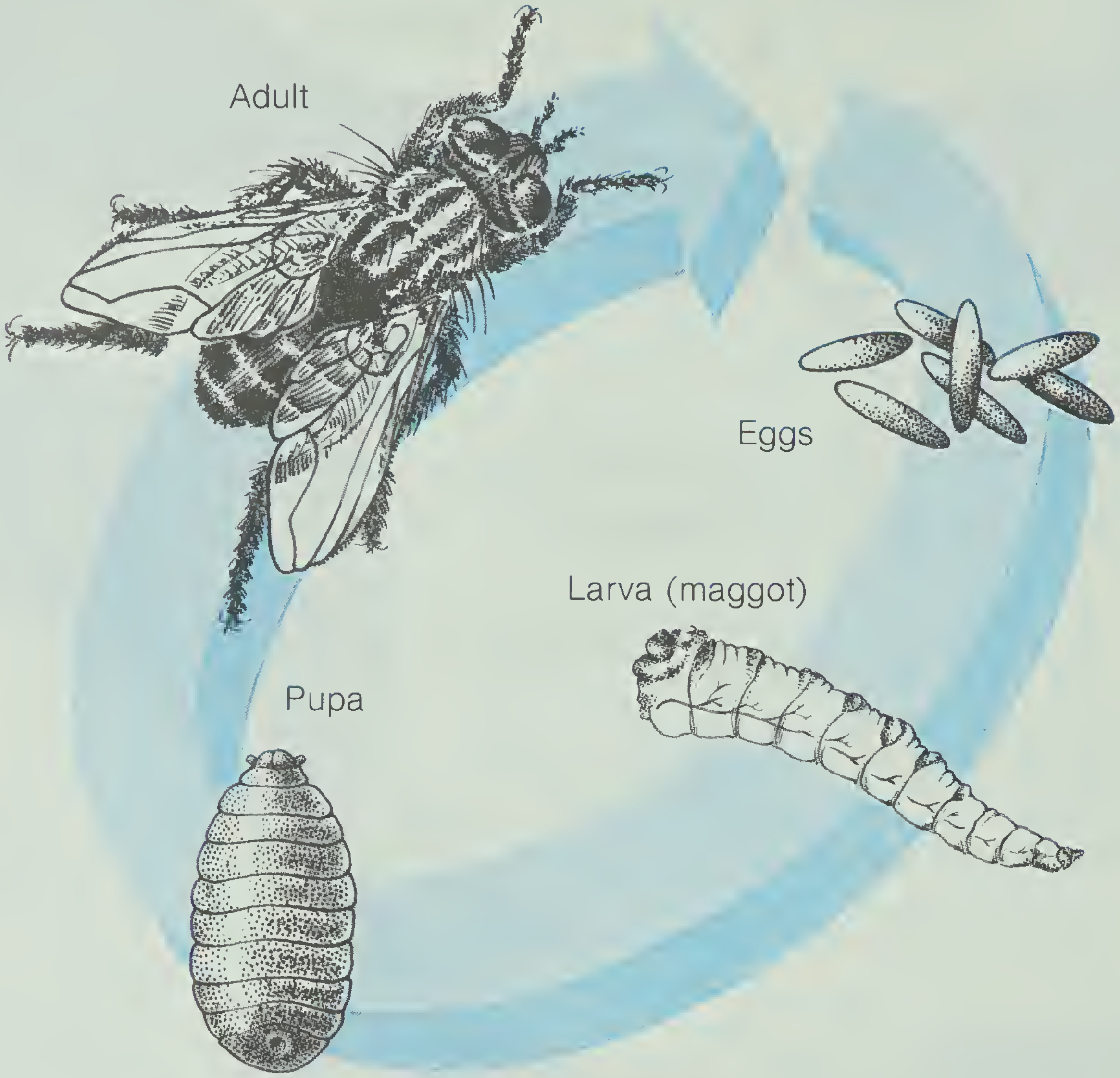


Figure 15–1

Figure 15–1 shows the four stages in the life cycle of the housefly.

✓ 15–1. In which stage would you expect the fly to grow the most? 15-1. Larva.

✓ 15–2. During which stage would you expect the fly to eat the most? 15-2. Larva.

A housefly lives its entire lifetime in about two to three weeks. In that time the adult female lays eggs about five times. Each time it lays about 120 eggs.

✓ 15–3. About how many eggs can the female housefly lay in a lifetime? 15-3. 120 eggs per time × 5 times = 600 eggs.

Flies do most of their eating and growing while they are maggots. A week-old maggot weighs about 50 times as much as a newly hatched maggot. The eggs, therefore, are almost always laid on top of a food supply. Animal droppings, garbage, garden refuse, rotting meat, and fruit are the most common breeding places.

★ **15-4. Towns that have garbage disposal and modern sewage-treatment plants usually have low housefly populations. How might you explain this?** 15-4. Sources of food for the maggots are kept to a minimum.

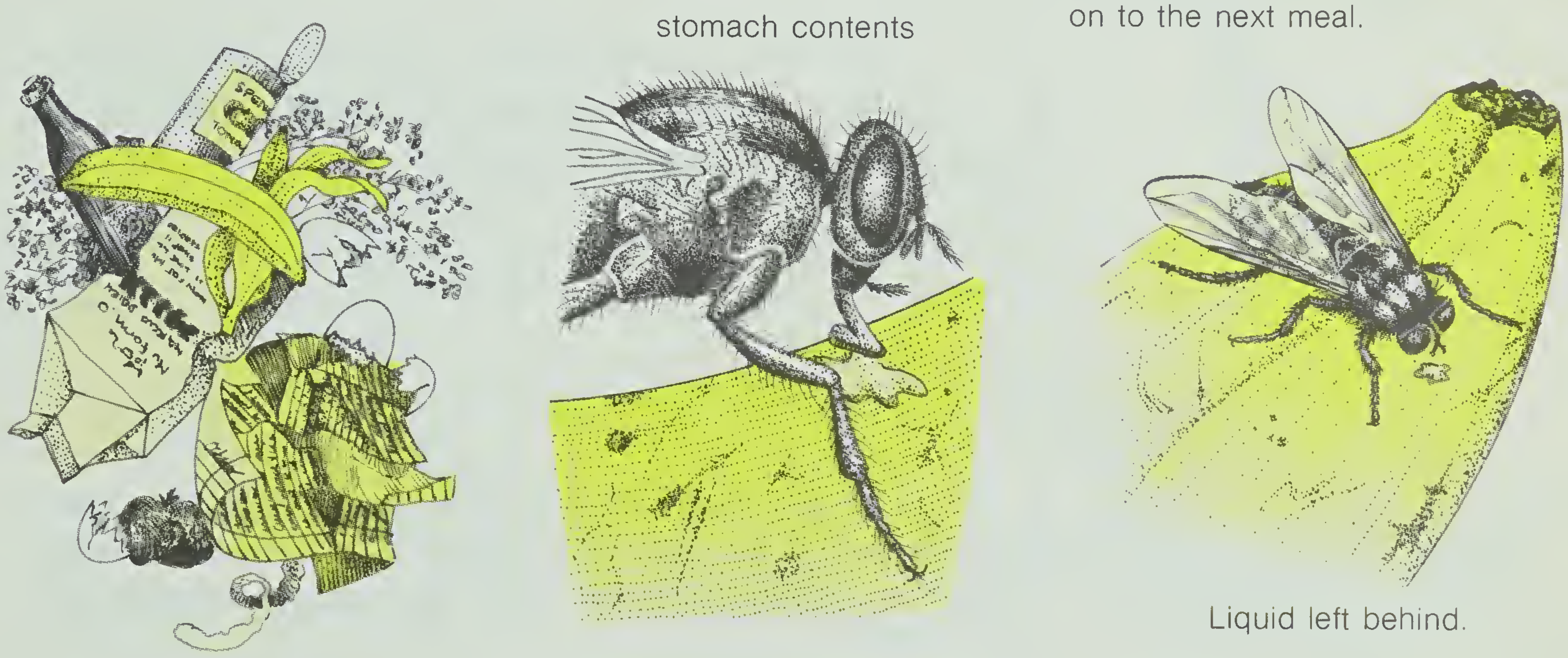
★ **15-5. Many towns have a rule against families keeping chickens, rabbits, and pigs in their backyard within the city limits. What are possible reasons for such a rule?**

15-5. Flies and other insects could use wastes from these animals as food. This would cause harmful amounts of such insects.

✓ 15-6. Most cities have a large population of dogs and cats. How does this cause an increase in the fly population of a city?

15-6. Maggots feed off of the wastes from such animals if these wastes are not controlled.

Houseflies don't bite or sting. But they can transfer disease to you through the food you eat. Figure 15-2 shows how disease is carried.



1. Housefly lands on manure or garbage containing disease germs.

Ejects part of stomach contents

2. Fly spits up fluid from content of stomach to help digest material.

3. Fly draws most of the liquid back into its stomach and moves on to the next meal.

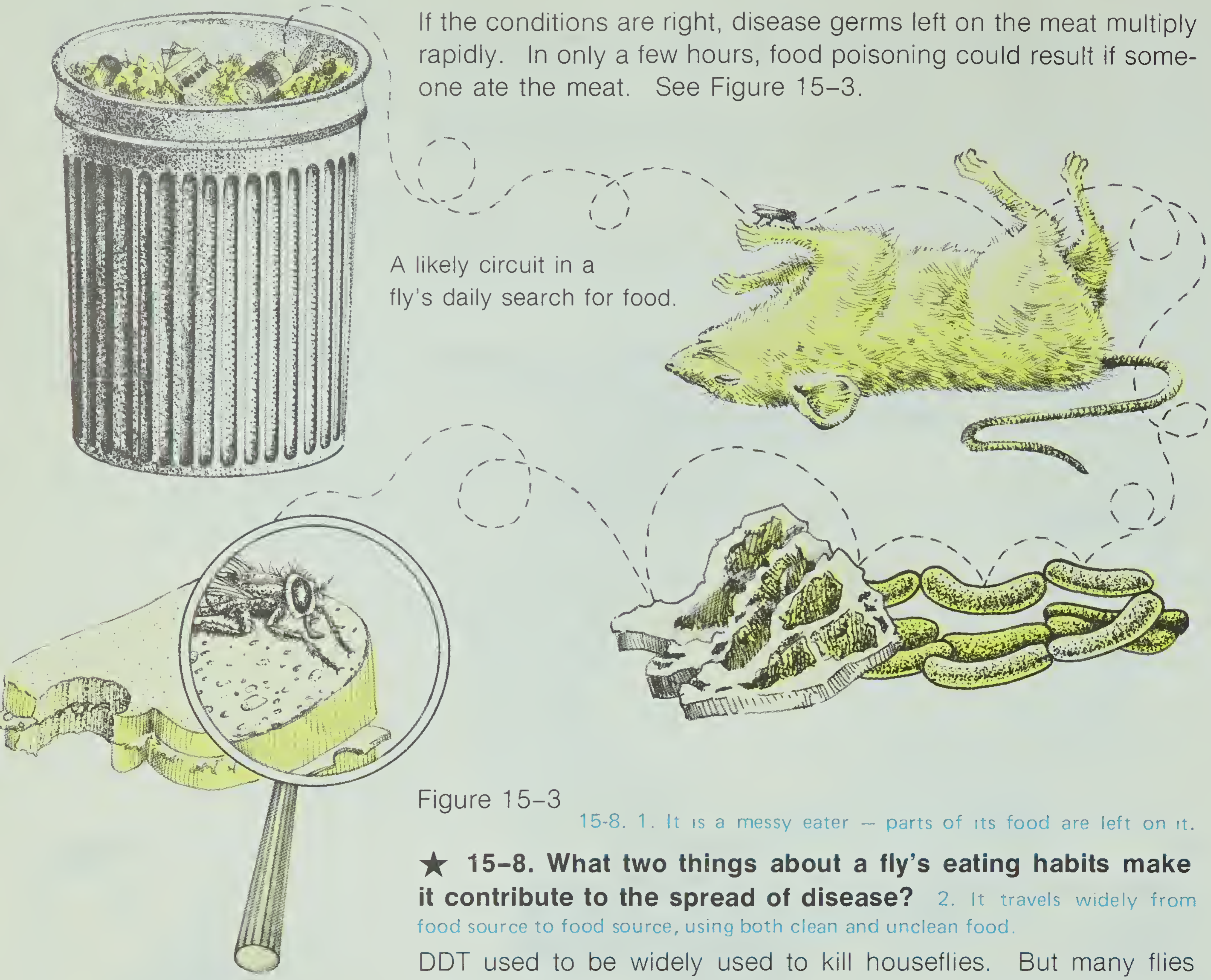
Liquid left behind.

Figure 15-2

✓ 15-7. Suppose after Step 3, the fly lands on some cooked meat. How are the disease germs that were on the manure or garbage transferred to the meat?

15-7. They are in the little bit of liquid that accumulates on the fly as it goes from place to place eating.

If the conditions are right, disease germs left on the meat multiply rapidly. In only a few hours, food poisoning could result if someone ate the meat. See Figure 15–3.



A likely circuit in a fly's daily search for food.

Figure 15–3

15-8. 1. It is a messy eater — parts of its food are left on it.

★ 15–8. What two things about a fly's eating habits make it contribute to the spread of disease? 2. It travels widely from food source to food source, using both clean and unclean food.

DDT used to be widely used to kill houseflies. But many flies developed a resistance to DDT, so DDT was no longer as effective.

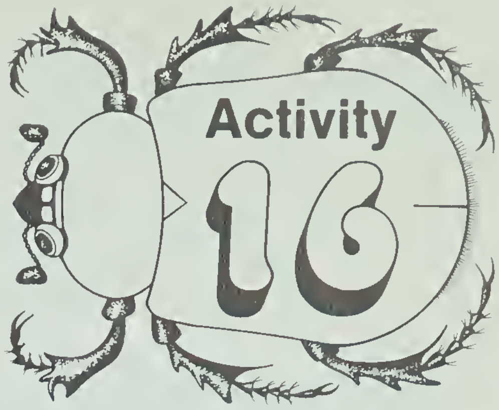
✓ 15–9. The use of DDT is banned in the United States. Why is this so? 15-9. DDT may be harmful to living things other than pests.

★ 15–10. The United States Department of Agriculture has recommended the following methods to reduce the number of flies in a given location. Give the reason behind each suggestion.

a. See that garbage cans have tight-fitting lids.
b. Clean up pet droppings regularly.
c. Do not set food where it can attract flies.
d. Use fly screens on windows and doors.
e. See that screened doors swing outward.
f. Clean up refuse around the yard.

15-10.
a. Eliminate one source of food for maggots.
b. Eliminate another source of food for maggots.
c. Eliminate a source of food for adult flies.
d. Prevent flies from entering your house to contaminate your food.
e. As you leave your house, flies will be pushed away from the door and will have difficulty getting into your house.
f. Eliminate sources of food for maggots.

Controlling Termites



ACTIVITY EMPHASIS: The identification and control of termites.

In early spring you might notice some bugs that look like ants flying around your house. Don't panic. Kill one of the bugs and take a look at it. If the bug has a narrow, stem-like connection between the second and third parts of the body, it's an ant. But if the connection is wide and fleshy, call an exterminator. You may have termites!

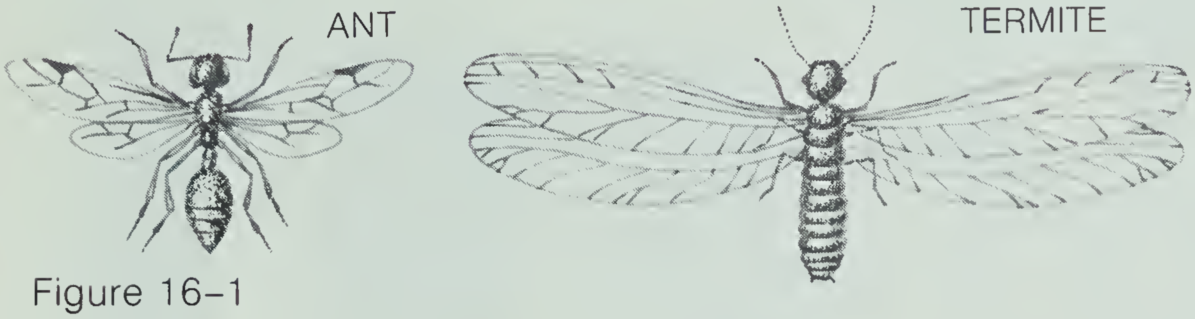


Figure 16–1

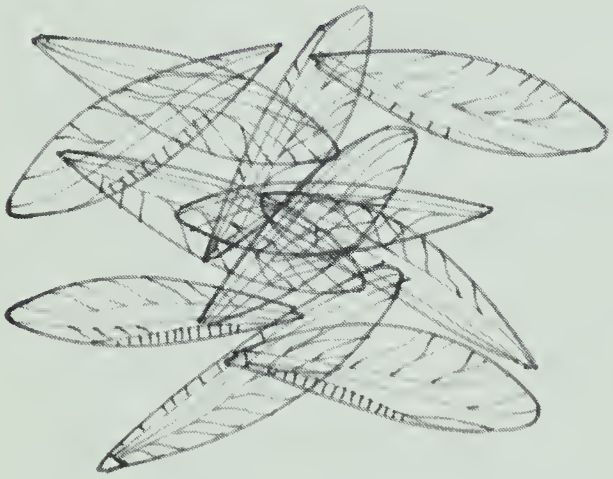
This is a reproductive termite. A male and a female fly off to form a new colony.

Termites are both harmful and helpful. They are pests because they eat wood. Thus they damage all kinds of wooden objects such as furniture, posts, poles, and piles of lumber. Termites are helpful in that they ventilate the soil. They also speed up the breakdown of dead trees into topsoil.

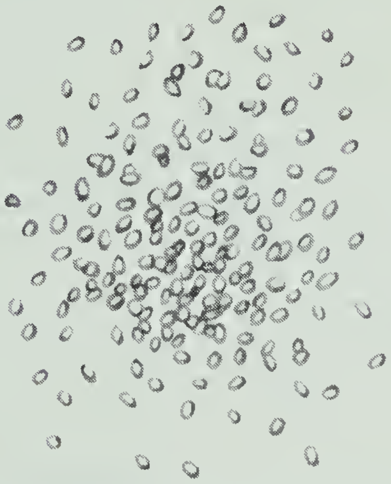
MATERIALS PER STUDENT UNIT
None.

HOW DO YOU KNOW IF YOU HAVE TERMITES?

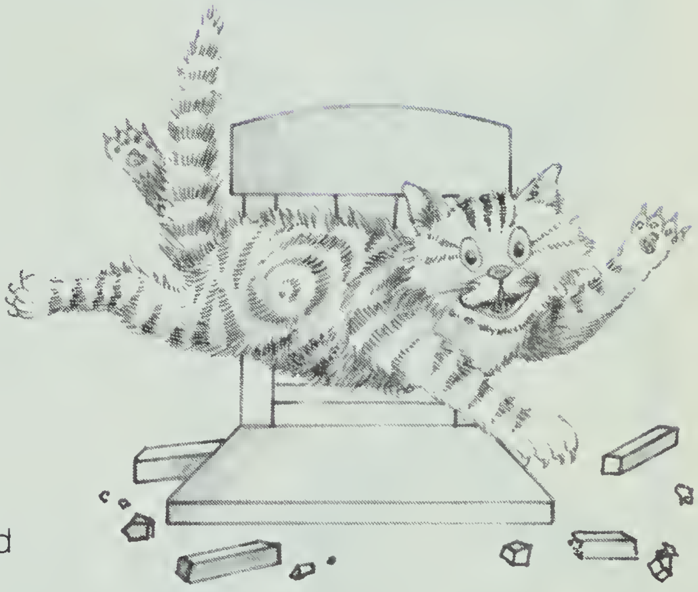
IF ANY OF THESE OCCUR, CALL AN EXTERMINATOR!



You may see several wings in and under furniture. These were shed by male and female reproductives.



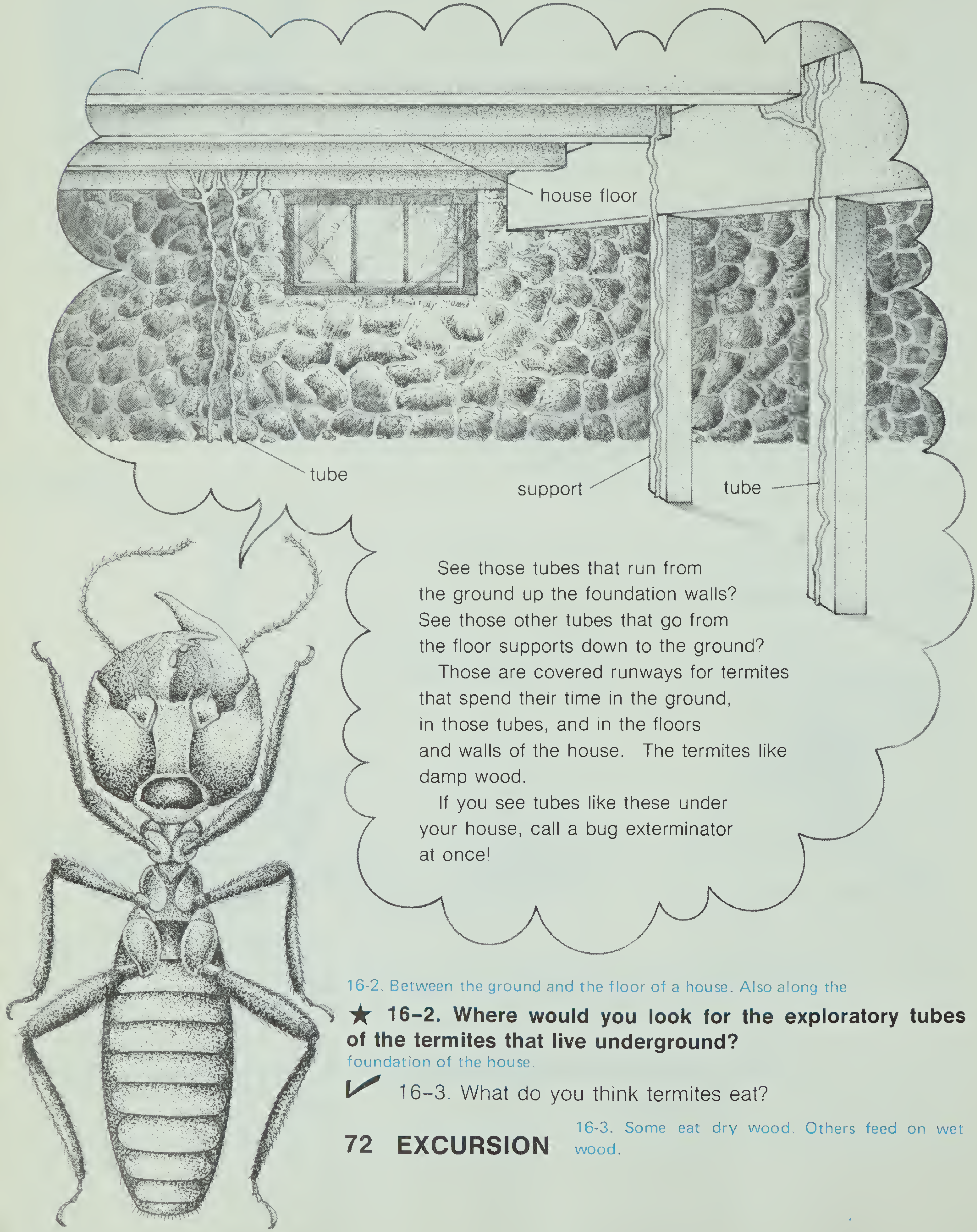
Termite droppings may be found around and under furniture. Droppings are pushed out of the tunnels as the termites work and eat.



Furniture that hasn't been treated roughly begins to break easily.

16-1. Collections of wings or droppings in and under furniture.

★ **16–1. What are some of the things you might see inside your home or apartment that would indicate you might have termites that live on dry wood?**



See those tubes that run from the ground up the foundation walls? See those other tubes that go from the floor supports down to the ground?

Those are covered runways for termites that spend their time in the ground, in those tubes, and in the floors and walls of the house. The termites like damp wood.

If you see tubes like these under your house, call a bug exterminator at once!

16-2. Between the ground and the floor of a house. Also along the foundation of the house.

★ **16–2. Where would you look for the exploratory tubes of the termites that live underground?**

✓ 16–3. What do you think termites eat?

16-3. Some eat dry wood. Others feed on wet wood.

16-4. Don't use fill dirt to support outside stairs. Be sure water drains away from the house. Put chemicals in the soil near (under) house to kill termites.

HOW TO CONTROL TERMITES

Promptly remove wooden construction trash from building site. Put shields on top of foundation which prevent termites from getting into the house.

★ 16–4. What are some of the ways you can control underground termites?

16-5. Easy breakage, collections of wings and/or droppings.

★ 16–5. What would you look for in inspecting a piece of second-hand furniture for termites?

TERMITE CONTROL:

Here are some helpful hints on termite control.

For Dry Wood Termites

Put screens on vents into the attic or under the house. This blocks the flying adults.

Apply a good coat of paint or wood preservative to exposed wood.

Don't bring furniture infested with termites into the house. Inspect used furniture and antiques. Look for brittle wood, wings, and droppings.

For Underground and Damp Wood Termites

Do not use dirt filling under stairs or floors.

Cap foundation with concrete. Metal shield acts as a barrier to exploratory tunnels.

Drainage of water should be away from the house.

Soil under a house to be built should be poisoned or fumigated.

Tree stumps and construction trash should be removed under and around the house.

WHAT TO DO:

If you see any signs of termites in your home or apartment, call a professional exterminator at once. Their inspection is often free, and they must be licensed by the city or state.

Activity 17

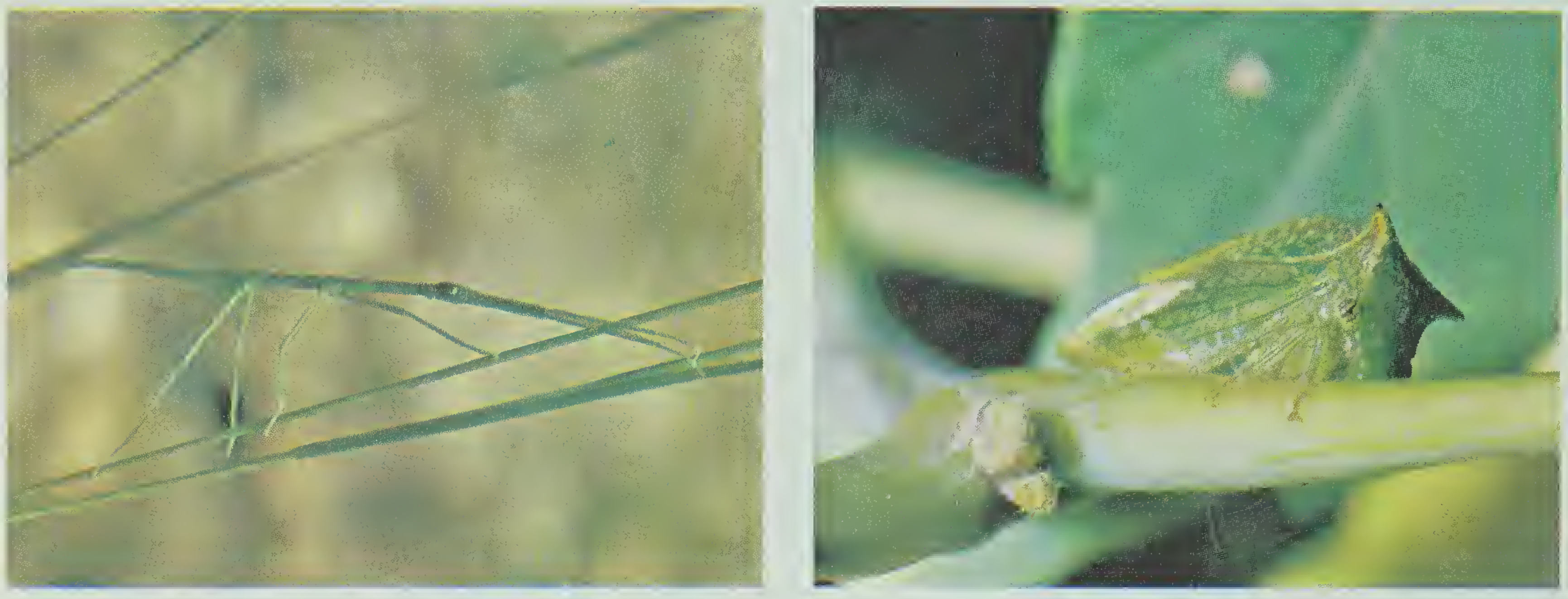
ACTIVITY EMPHASIS: A description of the methods of self-defense by which bugs protect themselves, such as mimicry and camouflage.

Bug Self-Defense

MATERIALS PER STUDENT UNIT

None.

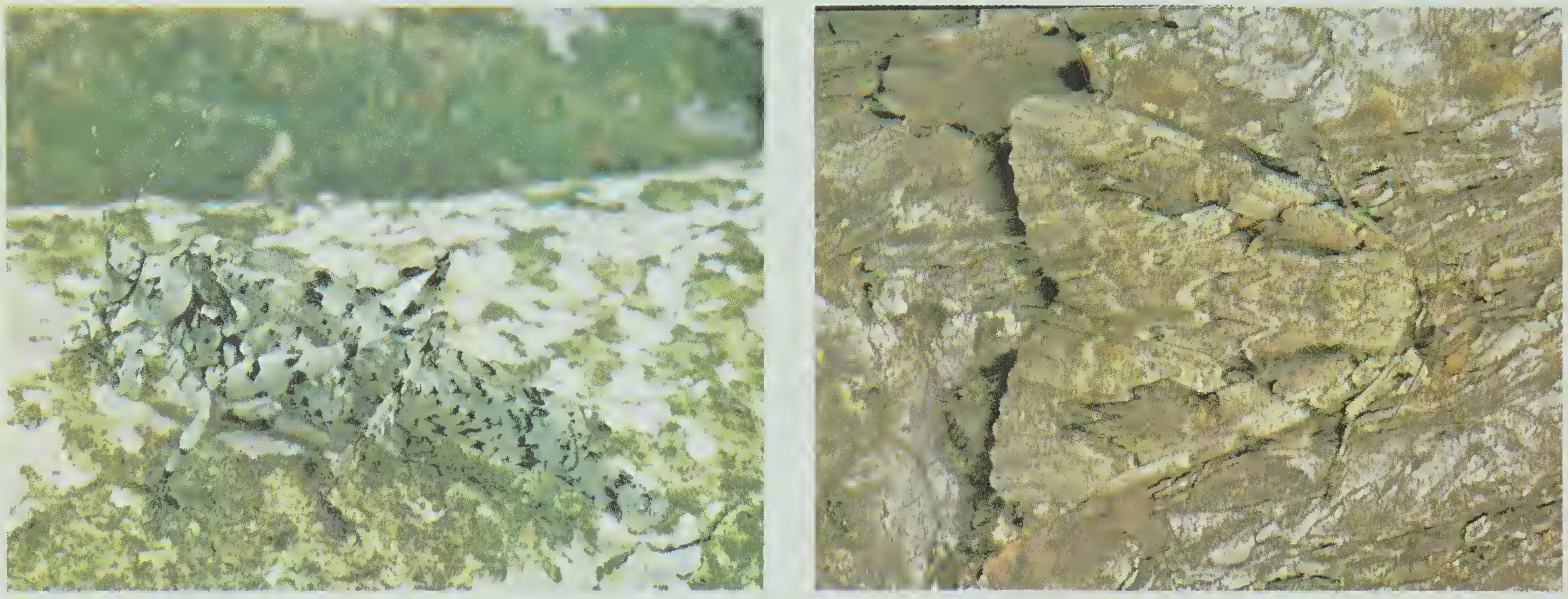
It's a pretty dangerous world for most bugs. Many birds, lizards, snakes, and frogs think a bug makes a tasty meal. To escape being eaten, many bugs have ways of fooling their enemies.



Walking stick on a twig.

Tree hopper on a rose bush.

Figure 17–1



Katydid on the bark of a tree.

Can you spot the moth?

Figure 17–2

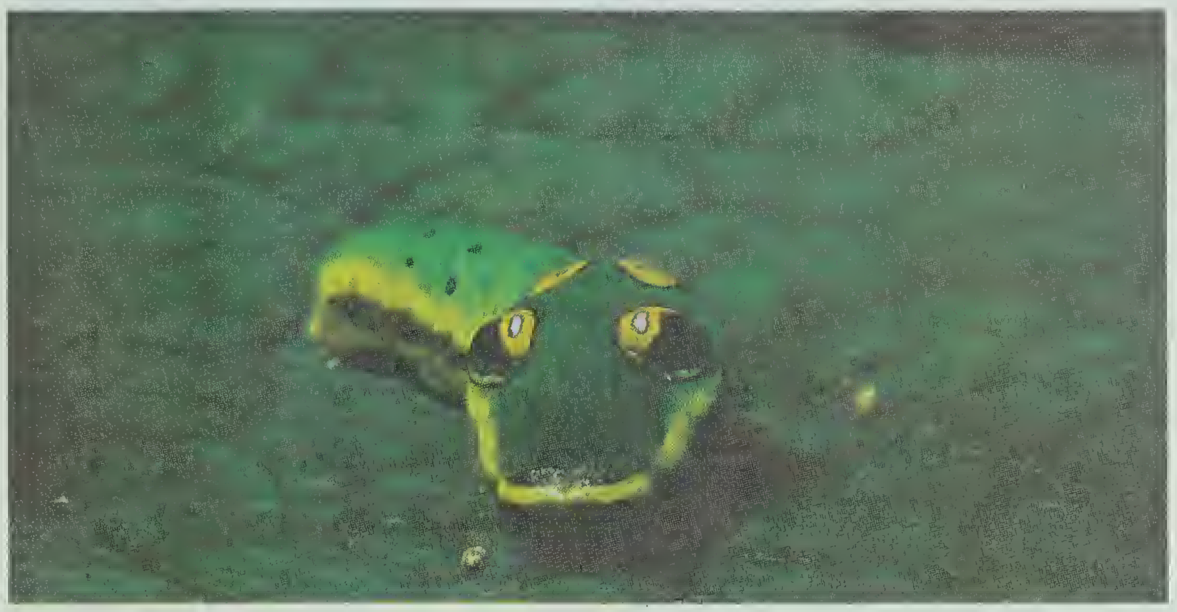
17-1. In Figure 17-1 the insects look like the twig or stem. In Figure 17-2 the insects blend into the tree bark, limb, or trunk.

✓ 17–1. How are the four bugs in Figure 17–1 and 17–2 protecting themselves from their enemies?

✓ 17–2. How are the methods of the walking stick and tree hopper different from those of the katydid and the moth?

17-2. Walking stick and tree hopper use mimicry to look like part of the tree. The katydid and moth use camouflage or protective coloration to blend in with the background.

Blending into the background is one way of self-defense. Mimicry — or looking like some part of the surroundings — is another. Some bugs have other ways of dealing with enemies.



Though harmless, the caterpillar looks ferocious when touched.

Figure 17–3

Caution your students not to touch spiny caterpillars. Many varieties are venomous.

17-3. It blends in with the twig. It also scares away its enemy.

✓ 17–3. What method of self-defense is the caterpillar in Figure 17–3 using?

by looking ferocious when touched.

★ **17–4. How does being able to escape being eaten affect the numbers of offspring an insect can produce?**

17-4. The better an insect can protect itself from being eaten, the more likely it will be to survive and produce offspring.

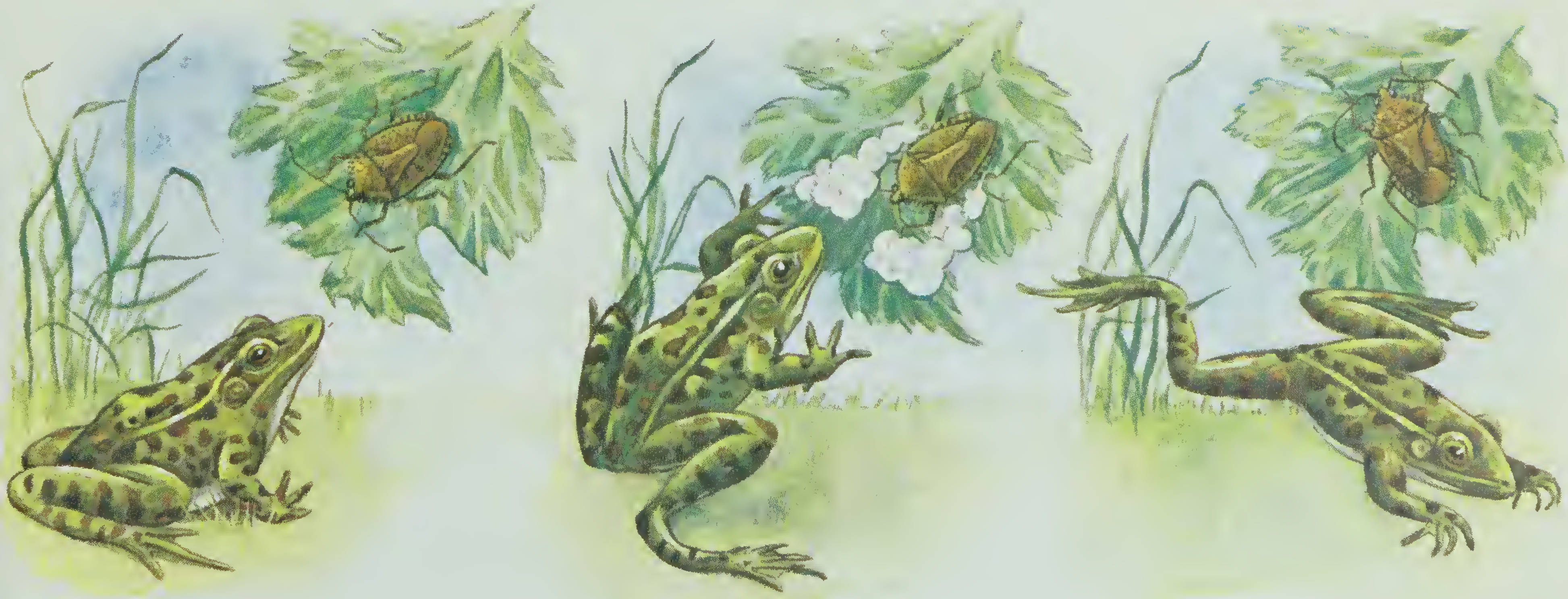


Figure 17–4

✓ 17–5. What method of self-defense is the bug in Figure 17–4 using?

17-5. The stink bug is spraying its enemy with an unpleasant spray.

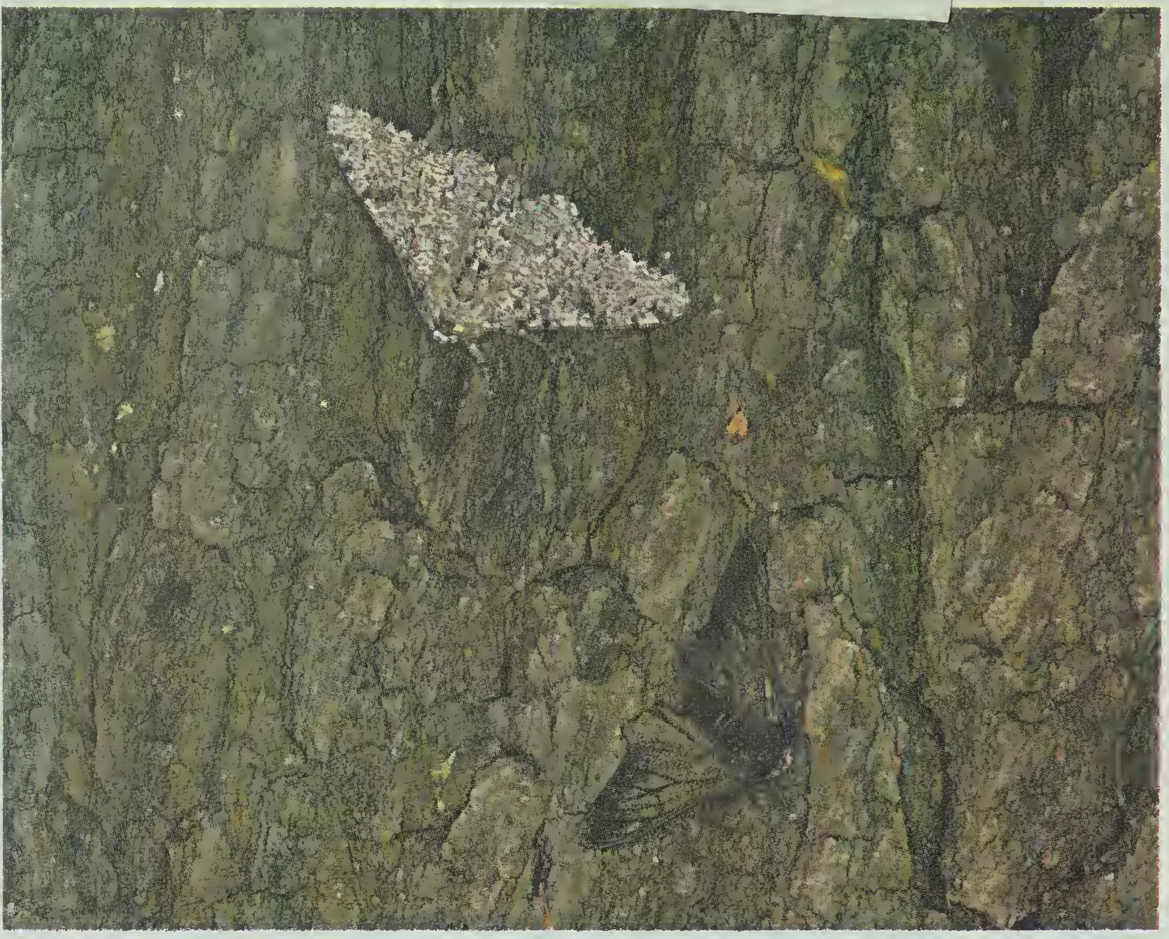


Figure 17–5

✓ 17–6. Which moth in Figure 17–5 would you expect to escape being eaten?

17-6. The dark peppered moth on a dark tree trunk.

Here's an idea for you Take a very careful look at the trees, shrubs, and other plants in your neighborhood. See if you can find any insects that are using some of the methods you've seen in this excursion. Make a list of these methods and sketch them in your notebook.

✓ 17–7. Take a look at the walking stick in Figure 17–1 again. By looking like the twigs and branches, it escapes many enemies. What's another advantage the walking stick has by mimicking its surroundings? 17-7. It can sneak up on its prey unnoticed.

✓ 17–8. Can you think of some other examples of how animals and people make use of mimicking their surroundings?

17-8. Answers will vary. Examples might include butterflies, birds, fish, and turtles using mimicry and camouflage; soldiers using camouflaged clothes and paint to blend in with the environment.

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